Drainage Summary Letter

FOR

Superior Marketplace

402 Center Drive
Superior, CO 80027

Prepared: 07/06/2022

for:

Confluence Companies
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Golden, CO 80401

by:

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HKS Project No.220633
Mark A. West, P.E., C.F.M.

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CERTIFICATION

I hereby affirm that this Drainage Summary Letter for Superior Marketplace was prepared under my direct supervision in accordance with the provisions of the City of Superior's *storm drainage criteria* for the owners thereof. I understand that the City of Superior does not and will not assume liability for drainage facilities designed by others.

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Mark A. West, P.E., C.F.M.
State of Colorado Registration No. 38561
On Behalf of Harris Kocher Smith

I. INTRODUCTION

A. SITE LOCATION

This report is provided to support the plan for Basin E of the Master Drainage Study prepared by Hydro-Triad / V3 Colorado, LLC in September 1999. The property is located in the northeast quarter of Section 24, and the southeast quarter of Section 13, Township 1 South, Range 70 West of the Sixth Principal Meridian, Town of Superior, County of Boulder, State of Colorado. The Site is bounded by basins A, B, C, D, G, and LW1 of the Master Drainage Plan. Additional information including the Master Drainage Plan and a Vicinity map can be found in the Appendices of this report.

B. SITE DESCRIPTION

The Site is comprised of approximately 4.69 acres of fully developed land with existing parking lots, utilities, water quality and detention ponds, and landscaped area. There are no known irrigation facilities on, adjacent to, or otherwise impacting the Site. See Appendix B for the existing site conditions.

The Site slopes generally to the East. According to the Natural Resources Conservation Service (NRCS) – Web Soil Survey, the underlying soils are valmont cobbly clam loam, which are classified as Hydrologic Group C (see Appendix A).

C. PROPOSED PROJECT DESCRIPTION

The Site will be developed as multi-family residential housing with 374 units in the 5-story building. The proposed development will also include a podium-parking garage in the bottom three floors of the building.

D. FLOOD HAZARD AND DRAINAGE STUDIES RELEVANT TO THE SITE

The Site is shown on the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM) Community Panel Number 08013C0583K, effective August 15, 2019. The Site is located within Zone X (area of minimal flood hazard). Please refer to Appendix A for more information. Because the Site will not have any constraints set upon it by floodplains, no floodplain modifications are necessary.

II. DRAINAGE STUDIES

A. MAJOR BASIN DESCRIPTION

The site lies within Superior Marketplace. The Proposed site will consist of multi-family housing, follow existing drainage patterns, and utilize the two water quality and detention basins to the east.

B. DETENTION AND WATER QUALITY

Detention and water quality will be provided by Detention Basins B1 and A2 from the Master Drainage Study. These basins were designed to capture an area of 32.24 aces at 90% imperviousness. The Site does not propose to increase either of these values, therefore the basins should be more than adequate for the intended improvements. See Appendix B for additional information.

III. CONCLUSIONS

A. IMPACT OF IMPROVEMENTS

Currently, the Site is mostly impervious parking lot, and flows are otherwise treated and detained. The proposed development includes the use of the existing storm drainage system conveying runoff from the majority of the Site to two on-site water quality ponds and detention facilities. The Superior Marketplace project will result in a minor improvement to the area storm drainage system.

B. COMPLIANCE WITH APPLICABLE CRITERIA

The design of the water quality, detention facility, and depth and velocity of street flow are in accordance with the criteria of Boulder County and Urban Drainage.

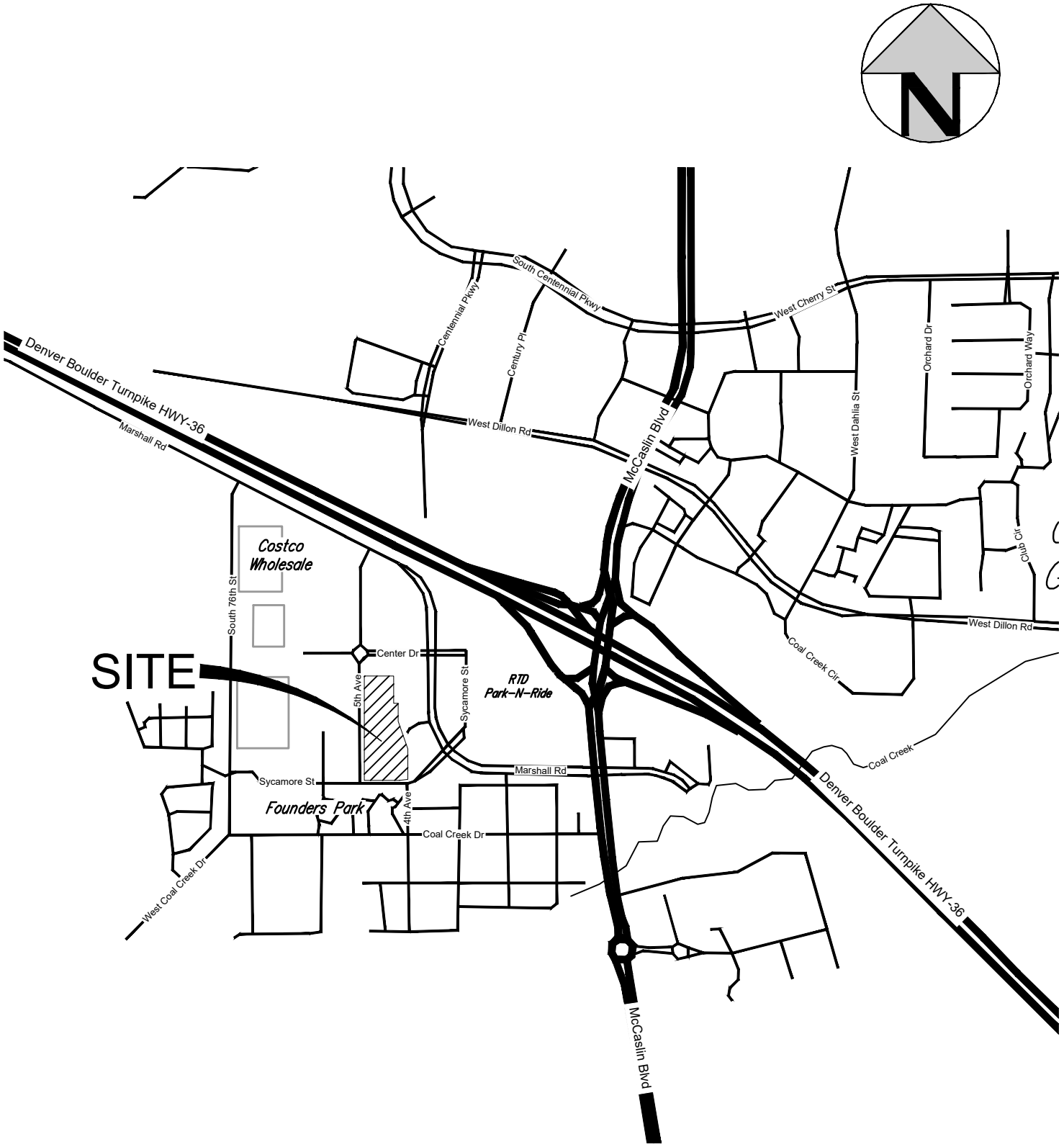
IV. REFERENCES

1. Master Drainage Study for Superior Marketplace, Hydro-Triad/V3 Colorado, LLC, dated September 17, 1999
2. *Storm Drainage Criteria Manual,* County of Boulder, Colorado, dated November 2016.
3. *Urban Storm Drainage Criteria Manual* (USDCM), Mile High Flood District (MHFD, formerly known as Urban Drainage and Flood Control District, UDFCD)*:*

   Volume 1, Management, Hydrology and Hydraulics, Revised August 2018.
   Volume 2, Structures, Storage and Recreation, Revised September 2017.
   Volume 3, Stormwater Quality, Updated October 2019.

APPENDIX A

Vicinity Map
Soil Report
FEMA Floodplain Map



VICINITY MAP - SUPERIOR MARKETPLACE

SCALE: 1"=1000'

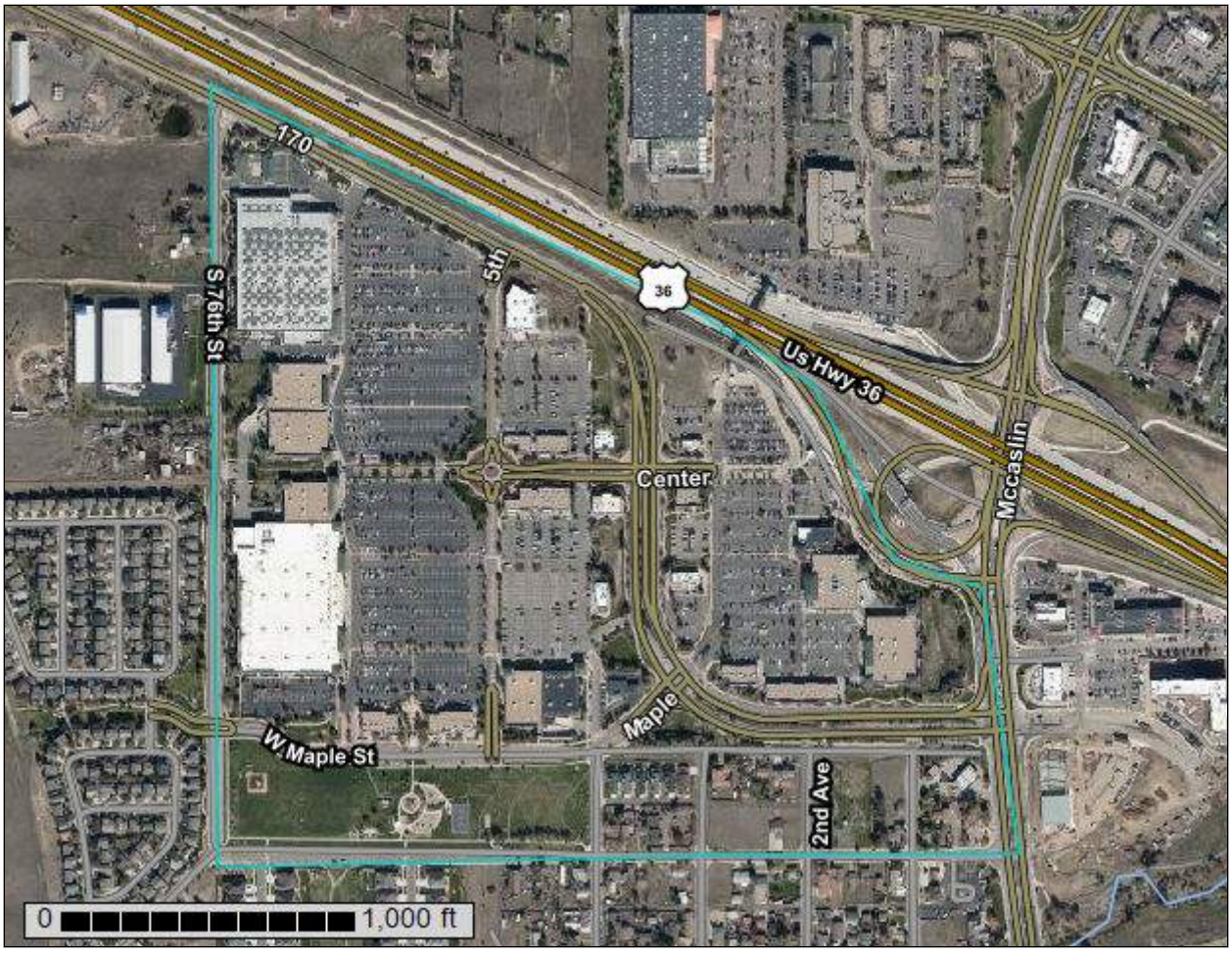
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Boulder County Area, Colorado



July 6, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boulder County Area, Colorado
Survey Area Data: Version 18, Sep 2, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 25, 2018—Apr 9, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AcA	Ascalon sandy loam, 0 to 3 percent slopes	0.2	0.2%
CaB	Calkins sandy loam, 1 to 3 percent slopes	0.1	0.0%
NdD	Nederland very cobbly sandy loam, 1 to 12 percent slopes	20.6	17.6%
NuB	Nunn clay loam, 1 to 3 percent slopes	0.1	0.1%
NuC	Nunn clay loam, 3 to 5 percent slopes	2.5	2.2%
VaB	Valmont clay loam, 1 to 3 percent slopes	47.1	40.3%
VaC	Valmont clay loam, 3 to 5 percent slopes	16.0	13.7%
VcC	Valmont cobbly clay loam, 1 to 5 percent slopes	15.5	13.3%
VcE	Valmont cobbly clay loam, 5 to 25 percent slopes	14.7	12.6%
Totals for Area of Interest		**116.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They

generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Boulder County Area, Colorado

AcA—Ascalon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2swl3
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ascalon and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk - 19 to 35 inches: sandy clay loam
C - 35 to 80 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Minor Components

Olnest

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Vona

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

CaB—Calkins sandy loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: jprc
Elevation: 4,900 to 5,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Calkins and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Calkins

Setting

Landform: Terraces, flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

H1 - 0 to 14 inches: sandy loam
H2 - 14 to 60 inches: sandy loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: OccasionalNone
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B
Ecological site: R067BZ031CO - Sandy Bottomland
Hydric soil rating: No

Minor Components

Mcclave

Percent of map unit: 6 percent
Ecological site: R067BZ035CO - Salt Meadow
Hydric soil rating: No

Valmont

Percent of map unit: 6 percent
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Nunn

Percent of map unit: 3 percent
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

NdD—Nederland very cobbly sandy loam, 1 to 12 percent slopes

Map Unit Setting

National map unit symbol: jps7
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 15 to 20 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Nederland and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nederland

Setting

Landform: Alluvial fans, terraces
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Cobbly loamy alluvium

Typical profile

H1 - 0 to 7 inches: very cobbly sandy loam
H2 - 7 to 20 inches: very cobbly sandy clay loam
H3 - 20 to 60 inches: very cobbly sandy loam

Properties and qualities

Slope: 1 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: R049XY213CO - Cobbly Foothill
Hydric soil rating: No

Minor Components

Valmont

Percent of map unit: 20 percent
Hydric soil rating: No

NuB—Nunn clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2tlpl
Elevation: 3,900 to 5,840 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Nunn and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nunn

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Pleistocene aged alluvium and/or eolian deposits

Typical profile

Ap - 0 to 9 inches: clay loam
Bt - 9 to 13 inches: clay loam
Btk - 13 to 25 inches: clay loam
Bk1 - 25 to 38 inches: clay loam
Bk2 - 38 to 80 inches: clay loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 7 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 0.5
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Minor Components

Heldt

Percent of map unit: 10 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Satanta

Percent of map unit: 5 percent

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

NuC—Nunn clay loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2tlpm
Elevation: 5,000 to 5,750 feet
Mean annual precipitation: 12 to 17 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 100 to 160 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Nunn and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nunn

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Pleistocene aged alluvium and/or eolian deposits

Typical profile

A - 0 to 6 inches: clay loam
Bt - 6 to 18 inches: clay
Btk - 18 to 30 inches: clay
Bk - 30 to 47 inches: clay loam
BCk - 47 to 80 inches: clay loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 7 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)

Sodium adsorption ratio, maximum: 0.5
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Minor Components

Satanta

Percent of map unit: 10 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

VaB—Valmont clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: jpsw
Elevation: 4,900 to 5,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Valmont and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Valmont

Setting

Landform: Fan remnants, terraces
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gravelly and cobbly loamy alluvium

Typical profile

H1 - 0 to 9 inches: clay loam
H2 - 9 to 29 inches: clay
H3 - 29 to 60 inches: very gravelly loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: C
Ecological site: R049XB208CO - Clayey Foothill
Hydric soil rating: No

Minor Components

Nunn

Percent of map unit: 8 percent
Ecological site: R067BY002CO - Loamy Plains, R067BY042CO - Clayey Plains
Hydric soil rating: No

Fluventic haplaquolls

Percent of map unit: 4 percent
Landform: Terraces
Hydric soil rating: Yes

Heldt

Percent of map unit: 3 percent
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

VaC—Valmont clay loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: jpsx
Elevation: 4,900 to 5,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Valmont and similar soils: 85 percent

Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Valmont

Setting

Landform: Fan remnants, terraces
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gravelly and cobbly loamy alluvium

Typical profile

H1 - 0 to 7 inches: clay loam
H2 - 7 to 24 inches: clay
H3 - 24 to 60 inches: very gravelly loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R049XB208CO - Clayey Foothill
Hydric soil rating: No

Minor Components

Nunn

Percent of map unit: 8 percent
Ecological site: R067BY002CO - Loamy Plains, R067BY042CO - Clayey Plains
Hydric soil rating: No

Heldt

Percent of map unit: 5 percent
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Fluventic haplaquolls

Percent of map unit: 2 percent
Landform: Flood plains
Hydric soil rating: Yes

VcC—Valmont cobbly clay loam, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: jpsy
Elevation: 4,900 to 5,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Valmont and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Valmont

Setting

Landform: Fan remnants, terraces
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gravelly and cobbly loamy alluvium

Typical profile

H1 - 0 to 8 inches: cobbly clay loam
H2 - 8 to 22 inches: clay
H3 - 22 to 60 inches: very gravelly loam

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R049XY213CO - Cobbly Foothill
Hydric soil rating: No

VcE—Valmont cobbly clay loam, 5 to 25 percent slopes

Map Unit Setting

National map unit symbol: jpsz
Elevation: 4,900 to 5,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Valmont and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Valmont

Setting

Landform: Fan remnants, terraces
Landform position (three-dimensional): Base slope, riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gravelly and cobbly loamy alluvium

Typical profile

H1 - 0 to 6 inches: cobbly clay loam
H2 - 6 to 18 inches: clay
H3 - 18 to 60 inches: very gravelly loam

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R049XY213CO - Cobbly Foothill
Hydric soil rating: No

Minor Components

Dacono

Percent of map unit: 9 percent
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Fluventic haplaquolls

Percent of map unit: 1 percent
Landform: Flood plains
Hydric soil rating: Yes

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

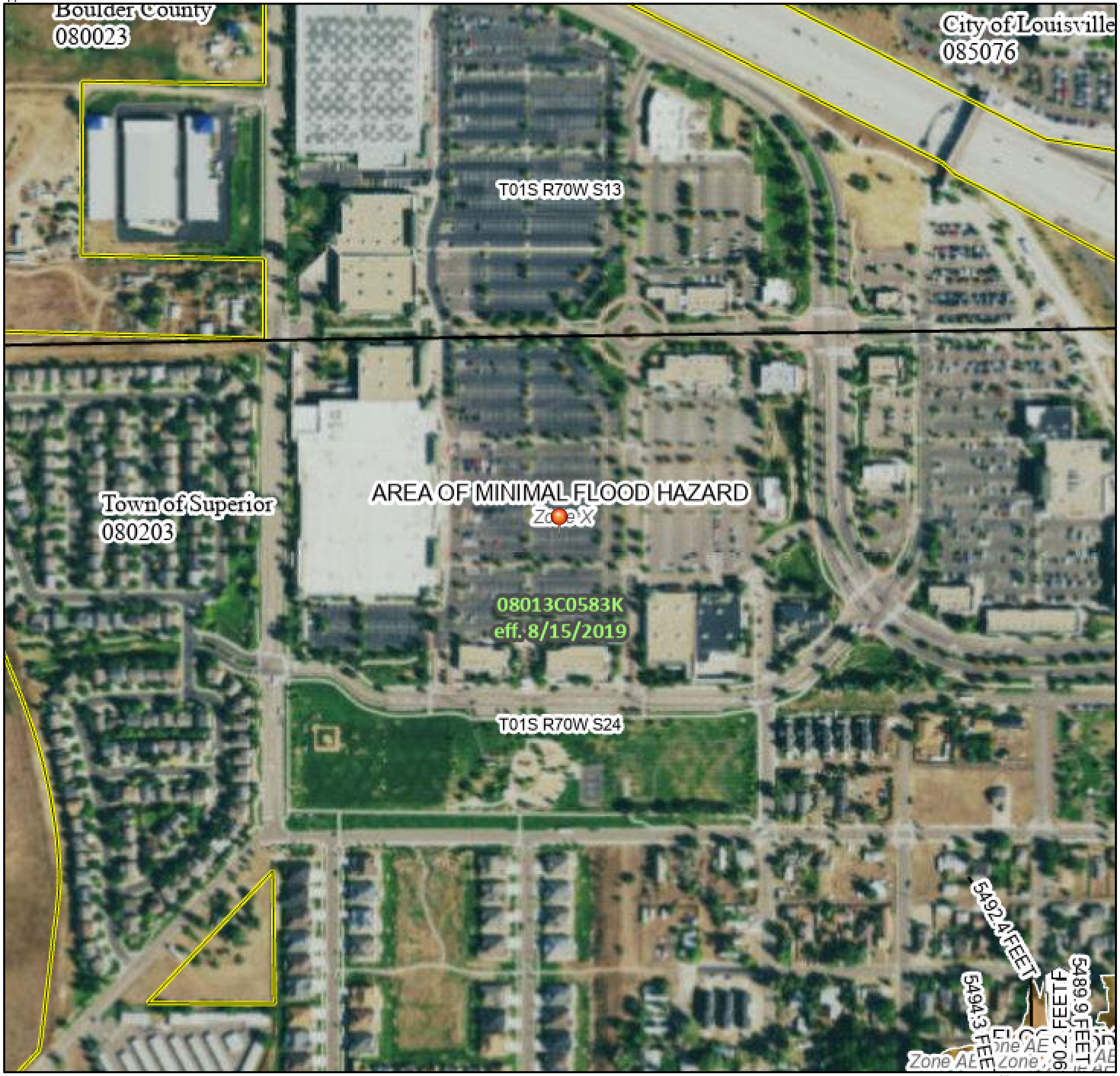
United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf


Boulder County
080023
City of Louisville
085076
T01S R70W S13
AREA OF MINIMAL FLOOD HAZARD
Zone X
Town of Superior
080203
08013C0583K
eff. 8/15/2019
T01S R70W S24
5492.4 FEET
5494.3 FEET
5489.9 FEET
Zone AE

APPENDIX B

Referenced Drainage Studies

HYDRO-TRIAD/ *V3 COLORADO, LLC*

Engineers and Consultants

Land Development • Infrastructure • Water Resources • GIS Services

MASTER DRAINAGE STUDY
FOR
SUPERIOR MARKETPLACE
SUPERIOR, COLORADO

Prepared For:
ELCOR DEVELOPMENT, LLC
AN ELLMAN COMPANY

Prepared By:
HYDRO-TRIAD / V3 COLORADO, LLC
200 UNION BLVD, SUITE 200
LAKEWOOD, COLORADO 80228

September 17, 1999

One of the
V3
Companies

MASTER DRAINAGE STUDY
FOR
SUPERIOR MARKETPLACE
SUPERIOR, COLORADO

Prepared For:
ELCOR DEVELOPMENT, LLC
AN ELLMAN COMPANY

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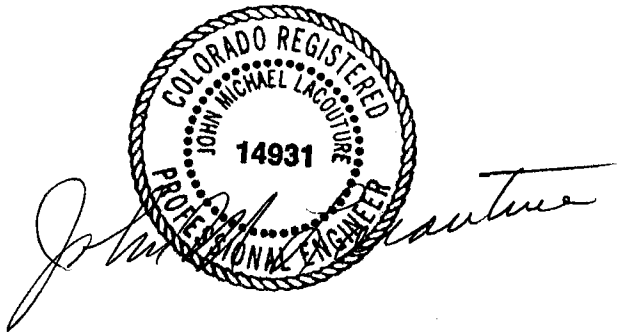
September 17, 1999



MASTER DRAINAGE STUDY, SUPERIOR MARKETPLACE

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1.0 INTRODUCTION

Superior Marketplace is a 96 acre office/retail development located at the southwest intersection of McCaslin Boulevard and the Boulder Turnpike (US 36).

The historical use of this property was agricultural/rural residential. A Master Drainage Plan for the development is required by the Town of Superior to ensure that the overall stormwater drainage system is managed and developed to address the following objectives:

- Quantify the total stormwater runoff to be generated by the development,
- Quantify and allocate all off-site stormwater runoff which will be routed through the development,
- Provide detention storage for on-site generated stormwater runoff to maintain historic release rates,
- Quantify detention volumes and off-site release rates, and
- Provide water quality treatment of stormwater runoff.

1.1 History of the Hydrologic Model

Previous studies for developing a Master Drainage Plan for the Superior Marketplace were conducted by the engineering firm of Martin/Martin, Inc (M/M). Considerable effort was expended in the collection of baseline data and hydrologic model development. Several hydrologic models were developed to simulate flows for historic and proposed development conditions within the site's watershed boundaries. Several revisions to the plan were submitted for review to McLaughlin Water Engineers (MWE) the Superior Metropolitan District 1 consultant, and RG Consulting Engineers the Town of Superior's Consultant. The latest plan revisions as presented by M/M were dated November 23, 1998.

Subsequent to the latest plan revision by M/M, MWE developed a hydrologic model for current conditions discharge to Coal Creek from existing Regional Detention Pond 11, the CDOT Swale and the Original Town of Superior. Pond 11 is located east of the Marshall Road and McCaslin Boulevard intersection and was previously design by EMK Consultants, Inc., documented in a report titled Addendum No.1 to the Final Drainage Study for McCaslin Boulevard Phase I, December 1993. The CDOT Swale is located along the south Right of Way line of the US 36. MWE developed the new model because current runoff flow conditions are different than the flows assumed in EMK's initial study. The Current Condition Model includes the following items:

- 60% of the restricted runoff from the Sagamore Development flows to Pond 11 and 40% flow through the Original Town of Superior to Coal Creek.
- A majority of the runoff from McCaslin Boulevard flows to Pond 11.
- 50% of the runoff from the Original Town of Superior flows to Pond 11, the other half flows directly to Coal Creek.
- Runoff from the undeveloped area west of 76th Avenue will flow through the Superior Marketplace site to the CDOT Swale. When this area, known as Basin 6 in EMK's Master Drainage Plan, dated April, 1989, the developed flows will be detained in a regional detention pond and restricted to historic peak flows.
- Runoff from undeveloped Superior Marketplace flows to the CDOT Swale and Pond 11.

The results of the Current Condition Model by MWE (presented in **Appendix H**) are total peak flows to Coal Creek of 195 cfs and 581 cfs for the 10-year and 100-year storm events, respectively.

MWE also developed a hydrologic model for developed conditions with the addition of Superior Marketplace being developed as proposed by M/M, called Revised Option 1 Model (presented in **Appendix I**). This model includes the addition of four ponds (A, B, C and D) on the Superior Marketplace site and a modification to Regional Detention Pond 11. Because 100% of the flow from the Sagamore Development is being directed to Pond 11, the 100-year peak discharge from Pond 11 can be increased without increasing the total peak flows to Coal Creek. The proposed increase in discharge from

Pond 11 requires the addition of a 42-inch diameter pipe at the Pond 11 outlet above the 10-year water elevation. The results of the Revised Option 1 model are total peak flows to Coal Creek of 192 cfs for the 10-year event and 582 cfs for the 100-year event; peak discharge and storage for Pond 11 of 75 cfs and 3.9 AF for the 10-year event and 239 cfs and 9.0 AF for the 100-year event and peak release rates to the CDOTswale at 91 cfs for the 10-year event and 287 cfs for the 100-year event. The Revised Option 1 Model matches the total peak flows to Coal Creek established in the Current Conditions Model.

Following these latest changes by MWE, Hydro-Triad / V3 Colorado (HTV3) became involved in the Master Drainage Plan as authorized by Elcor Development to review the work performed to date and recommend further changes to the model to obtain more optimal detention basin sizing.

MWE provided files of their latest model to HTV3, which became the basis for further work on the model. This report documents HTV3's work efforts and results to finalize the MWE model and present alternative solutions for developed conditions that are consistent with the Town's drainage criteria and the developer's objectives without increasing the peak flows from Pond 11 and the CDOT Swale from those flows established in the aforementioned Revised Option 1 Model.

It should be noted that no changes were made by HTV3 to the hydrologic models for historic basin conditions, because the results from these models were found acceptable by MWE.

2.0 SCOPE OF REPORT

Due to the considerable work and previous studies conducted by others on the Master Drainage Plan, this report addresses only developed conditions. For purposes of continuity, data and information developed by M/M which are relevant to historic basin conditions and other data for developed conditions that were not altered as part of this report are included in **Appendix G**. The reader is referred to the latest M/M full report,

dated November 23, 1998 for further details. MWE's Current Condition Model and Revised Option 1 Model are also included as reference in **Appendix H and I**, respectively. Where necessary, this report presents the background data, charts and tables to substantiate and document the changes that were made to the base models.

3.0 PROJECT LOCATION

The proposed Superior Marketplace property consists of approximately 96 acres. The property is located in the northeast quarter of Section 24, and the southeast quarter of Section 13, Township 1 South, Range 70 West of the Sixth Principal Meridian, Town of Superior, County of Boulder, State of Colorado. See Vicinity Map on **Drawing 1.0**.

The proposed development consists of commercial/office/retail buildings with associated parking. Offsite development (Sagamore Subdivision) exists to the west, and to the south exists the original Town of Superior. The site is bordered by the US 36 on the north, McCaslin Boulevard on the east, 76th Avenue on the west and Maple Avenue and Coal Creek Drive on the south.

4.0 DESIGN CRITERIA

4.1 General Analysis Methodology

Developed on-site runoff flows were calculated by both M/M, MWE and HTV3 using methods described in the *Urban Storm Drainage Criteria Manual* (MANUAL), and in the *Boulder County Storm Drainage Criteria Manual* (CRITERIA). Design Charts from the MANUAL and the CRITERIA are given in **Appendix A**.

As outlined in CRITERIA, runoff flows were determined for the minor (10-year) and major (100-year) design storms. The majority of the basin characteristics were previously determined by M/M and MWE, with basin characteristics added or modified by HTV3 as given in **Appendix B**. The Colorado Urban Hydrograph Procedure Computer Model

(CUHP/PC) and the Urban Drainage Storm Water Management Model (UDSWM) were used as tools to determine runoff flows. Off-site runoff and historic flows determined by others and used by HTV3 were those approved by MWE.

4.2 Conveyance Structures

Storm sewer pipes and inlets shown on the drainage plan (**Drawing 1.0**) for the parcel east of the relocated Marshall Road are indicated for conceptual purposes and have been preliminarily sized using full flow capacity. The actual size and locations will be determined for each parcel being developed. Storm sewer pipes shown for the parcels to the west and south of Marshall Road reflect either as-built conditions (Phase I) or proposed design sizes for Phase II. Phase I work includes the design and construction of storm sewer lines 1 through 6 (see design drawings). The proposed storm sewer pipes will be sized for a minimum velocity of 2 fps and a maximum velocity of 15 fps for the 10-year event and 20 fps for the 100-year event.

4.3 Historic Flows & Existing Detention Facilities

The historic runoff from the site sheet flows across the site to two existing 60 inch RCP culverts located at US 36 and McCaslin Boulevard and an existing 6-foot x 4-foot box culvert underneath McCaslin Boulevard. The two 60-inch culverts discharge into a CDOT Swale along US 36 which discharges into Coal Creek a short distance downstream. The flow at the entrance to the two 60-inch culverts has been approved by MWE to be 91 cfs for the 10-year event and 287 cfs for the 100-year event. The 6-foot x 4-foot box culvert below McCaslin Boulevard discharges directly into Regional Detention Pond 11, directly east of McCaslin Boulevard. Regional Detention Pond 11 has been approved by MWE for a maximum 10-year and 100-year storage volume of 3.9 and 9.0 acre-feet and a maximum 10-year and 100-year discharge of 75 and 239 cfs, respectively.

Detention Basin C was designed and constructed as part of M/M's Phase I work. Detention Basin C has been approved by MWE for a 10-year and 100-year storage volume of 3.6 and 6.1 acre-feet and a maximum 10-year and 100-year discharge of 85 and 262 cfs, respectively.

5.0 PROPOSED DRAINAGE IMPROVEMENTS

The primary criteria for the proposed drainage improvements for the developed site are that outflows to Coal Creek for the 10-year and 100-year events will not be increased beyond the historic or preexisting condition flows. The required storage volume and peak flows from Regional Detention Pond 11 and peak flows from the CDOT Swale for the 10-year and 100-year events, established by MWE's Revised Option 1 Model, will not be exceeded.

5.1 Watershed Basin Delineation

HTV3 modified the delineation of the watershed subbasins by MWE to change the routing of storm water runoff as explained below:

- Subbasin H previously included a portion of Marshall Road Right of Way. The Marshall Road Right of Way was separated from Subbasin H to form Subbasin LW1 because its runoff discharges directly into the upstream main collector storm sewer in lieu of sheet flow through Subbasin H. Also included in Subbasin LW1 is a portion of Subbasin E that does not drain to Detention Basin B but to Detention Basin D.
- Subbasin LW2 was formed from a portion of Marshall Road Right of Way that was previously part of Subbasin H. Stormwater runoff from Subbasin LW2 does not drain to Detention Basin D as the storm water runoff from Subbasin H does, but does drain directly to the existing Regional Detention Pond 11 through the box culverts.
- A portion of Sycamore Street, west of Detention Basin A was included in Subbasin B because stormwater runoff from this area flows to Detention Basin A in Subbasin B.

- A section of Subbasin D, within the proposed Target parking lot was separated from Subbasin D and included in Subbasin A. The storm water runoff in this section runs to inlets that contribute to Detention Basin A.

Refer to the Drawing 1.0 for basin delineation. Hydrologic characteristics for the subbasins are given in **Appendix B.**

Watershed basin hydrographs were generated using CUHP/PC. Input and output files for the 10-year and 100-year models are included in **Appendix C**.

5.2 Storm Runoff Routing

Watershed subbasin stormwater runoff routing was performed using UDSWM. A diagram of the UDSWM model is shown on **Drawing 2.0** with sections modified by HTV3. UDSWM input and output files are given in **Appendix D**.

Modifications included adding an overflow bypass around Detention Basin A to convey a portion of Sagamore Subdivision offsite runoff flows. The overflow bypass will be designed to allow flows into Detention Basin A not to exceed 169 cfs from the diversion structure. The overflow bypass will rejoin the storm water system immediately downstream of Detention Basin A.

Other modifications included adding a diversion structure upstream of Detention Basin D to divert storm water into the CDOT swale at rates less than or equal to the historic flows.

Several design points were added to or deleted from the UDSWM Model for purposes of additional output information. These additional design points do not affect the routing analysis.

6.0 ON-SITE DETENTION BASINS

The detention basins were designed to ensure that the discharge from the developed site will not exceed the historic flows as approved by MWE to the CDOT swale and Regional Detention Pond 11.

Detention volumes for each subbasin area were calculated for the minor storm (10-year) and for the major storm (100-year), using the UDSWM Model. Water Quality Capture Volume (WQCV) and Sediment Volume for each basin was calculated using the method outlined in the MANUAL.

Five detention basins (A1, A2, B, C and D) were designed to detain on-site runoff. As mentioned previously, Detention Basin C was designed by M/M. Detention Basins A1, A2, B and D are proposed detention basins and preliminary design has been completed by HTV3. Note that A1 and A2 are hydraulically connected and were modeled as one detention basin (Detention Basin A). The elevation vs. storage data for each detention basin is shown on **Table 1.0**.

6.1 Storm Water Requirements

The detention basin locations and storm water requirements are described below.

Detention Basin A1 and A2

Detention Basin A1 and A2 are located south and northwest of the intersection of Marshall Road and Sycamore Street and receive stormwater runoff on-site from Subbasin A, B, and C and off-site from the Sagamore Subdivision. The detention basins are hydraulically connected by a culvert. It was determined that Detention Area A has a required 10-year storm volume of 2.5 acre-ft and 100-year storm volume of 4.4 acre-ft. The storage volume for water quality and sediment is 0.5 ac-ft. The peak inflow to Detention Basin A is 78 cfs for the 10-year event and 176 cfs for the 100-year event and the peak outflow will be restricted to 50 cfs for the 10-year event and 134 cfs for the 100-year event. Storage-discharge-elevation data for Detention Basin A are shown on **Table 2.0**

Detention Basin B

Detention Basins B is located at the east edge of Subbasin E and receives stormwater runoff from Subbasin D and Subbasin E. This detention basin has a required 10-year storm volume of 2.0 acre-ft and 100-year storm volume of 2.3 acre-ft. The storage volume for water quality and sediment is 0.9 ac-ft. The peak inflow to Detention Basin B is 81 cfs for the 10-year event and 132 cfs for the 100-year event and the peak outflow will be restricted to 10 cfs for the 10-year event and 64 cfs for the 100-year event. Storage-discharge-elevation data for Detention Basin B are shown on **Table 2.0**.

Detention Basin D

Detention Basin D is located at the intersection of Marshall Road and McCaslin Boulevard and receives stormwater runoff from Subbasin H, I and LW1. It was determined that Detention Basin D has a required 10-year storm volume of 2.8 acre-ft and 100-year storm volume of 4.8 acre-ft. The storage volume for water quality and sediment is 1.3 ac-ft. The peak inflow to Detention Basin D is 70 cfs for the 10-year event and 119 cfs for the 100-year event and the peak outflow will be restricted to 10 cfs for the 10-year event and 40 cfs for the 100-year event. Storage-discharge-elevation data for Detention Basin D are shown on **Table 2.0**.

6.2 Water Quality and Sediment

Each detention basin is sized to accommodate storage volume for water quality and sediment purposes. This storage volume is determined based on area and percent impervious of the contributory subbasin. WQCV and Sediment Volume requirements were determined by HTV3 using the MANUAL. These volume requirements are shown on **Table 2.0**.

Total required and actual volumes for each detention basin is shown on **Table 3.0**.

6.3 Detention Basin Outlet Structures

The design of the detention basin outlet structures will be based on the following objectives:

- Release stormwater runoff at the 10-year and 100-year discharge rates determined by HTV3,
- Detain 10-year and 100-year stormwater runoff volumes,
- Detain stormwater runoff to release WQCV in a 40 hour period, and
- Maintain a dry basin bottom between storm events.

Preliminary design calculations for detention pond outlet structures are included in **Appendix E**.

7.0 SUMMARY

This report presents the modifications made by HTV3 to the Master Drainage Study for the Superior Marketplace. Modifications were made using methods given in the MANUAL and the CRITERIA.

The 10-year and 100-year storm volumes (3.8 and 9.0 acre-feet) and peak flows (74 and 238 cfs) for existing Regional Detention Pond 11 and peak flows (92 and 285 cfs) to the CDOT Swale meet the CRITERIA.

Table 1.0

MASTER DRAINAGE STUDY, SUPERIOR MARKETPLACE
Elevation vs. Capacity of Detention Basins

Detention Basin A Basin A1				
Elevation (ft)	Area (ft^2)	Incremental Volume (ft^3)	Cumulative Volume (ft^3)	Cumulative Volume (ac-ft)
5494	0			
5495	8,839	2,946	2,946	0.07
5496	10,516	9,678	12,624	0.29
5497	10,586	10,551	23,175	0.53
5498	10,656	10,621	33,796	0.78
5499	10,726	10,691	44,487	1.02
5500	10,796	10,761	55,248	1.27
5500	12,060	--	--	--
5501	12,130	11,463	66,711	1.53
5502	12,200	12,165	78,876	1.81
5503	12,270	12,235	91,111	2.09
5504	12,340	12,305	103,416	2.37
5505	12,410	12,375	115,791	2.66
5506	12,480	12,445	128,236	2.94

Detention Basin A Basin A2				
Elevation (ft)	Area (ft^2)	Incremental Volume (ft^3)	Cumulative Volume (ft^3)	Cumulative Volume (ac-ft)
5496	0			
5497	934	311	311	0.01
5498	5,057	2,996	3,307	0.08
5499	7,183	6,120	9,427	0.22
5500	7,243	7,213	16,640	0.38
5501	7,504	7,374	24,013	0.55
5502	7,732	7,618	31,631	0.73
5503	7,945	7,839	39,470	0.91
5504	8,099	8,022	47,492	1.09
5505	8,255	8,177	55,669	1.28
5506	8,335	8,295	63,964	1.47

Table 1.0

MASTER DRAINAGE STUDY, SUPERIOR MARKETPLACE
Elevation vs. Capacity of Detention Basins

Detention Basin B				
Elevation (ft)	Area (ft^2)	Incremental Volume (ft^3)	Cumulative Volume (ft^3)	Cumulative Volume (ac-ft)
5495	0			
5496	3,091	1,030	1,030	0.02
5497	11,069	7,080	8,110	0.19
5498	11,371	11,220	19,330	0.44
5499	11,481	11,426	30,756	0.71
5500	11,590	11,536	42,292	0.97
5501	11,676	11,633	53,925	1.24
5502	11,762	11,719	65,644	1.51
5503	11,848	11,805	77,449	1.78
5504	11,934	11,891	89,340	2.05
5504	15,000	--	--	--
5505	15,088	15,044	104,384	2.40

Detention Basin D				
Elevation (ft)	Area (ft^2)	Incremental Volume (ft^3)	Cumulative Volume (ft^3)	Cumulative Volume (ac-ft)
5479	0			
5480	3,386	1,129	1,129	0.03
5481	21,704	12,545	13,674	0.31
5482	31,606	26,655	40,329	0.93
5483	31,680	31,643	71,972	1.65
5483	38,500	--	--	--
5484	38,574	38,537	110,509	2.54
5485	38,648	38,611	149,120	3.42
5486	38,722	38,685	187,805	4.31
5486.6	38,766	23,246	211,051	4.85

Table 2.0

MASTER DRAINAGE STUDY, SUPERIOR MARKETPLACE
Detention Basin Requirements

Detention Basin		WQCV and Sediment		10 Year Event			100 Year Event		
Name	Bottom Elevation (ft)	Storage[2] Volume (ac-ft)	Elevation[3] (ft)	Storage[2] Volume (ac-ft)	Elevation[3] (ft)	Release Rate (cfs)	Storage[2] Volume (ac-ft)	Elevation[3] (ft)	Release Rate (cfs)
A	5494	0.5	5497	2.5	5502	50	4.4	5506	134
B	5495	0.9	5500	2.0	5504	10	2.3	5505	64
D	5479	1.3	5483	2.8	5484.3	10	4.8	5486.6	40
11	See Note 4	See Note 4		3.8	See Note 4	74	9.0	See Note 4	238

NOTES:

1. WQCV and Sediment were determined by methods outlined in Urban Storm Drainage Criteria Manual Volume 3.
2. 10 and 100 Year Event Storm Volume and Release Rates were determined by CUHP/PC, 1985 and USDSWM386, 1996.
3. Elevations were determined by elevation / capacity data generated by Hydro-Triad/V3.
4. Pond 11 data available from EMK Consultant's Report dated December 1993

Table 3.0

MASTER DRAINAGE STUDY, SUPERIOR MARKETPLACE
Detention Basin Storage Volumes

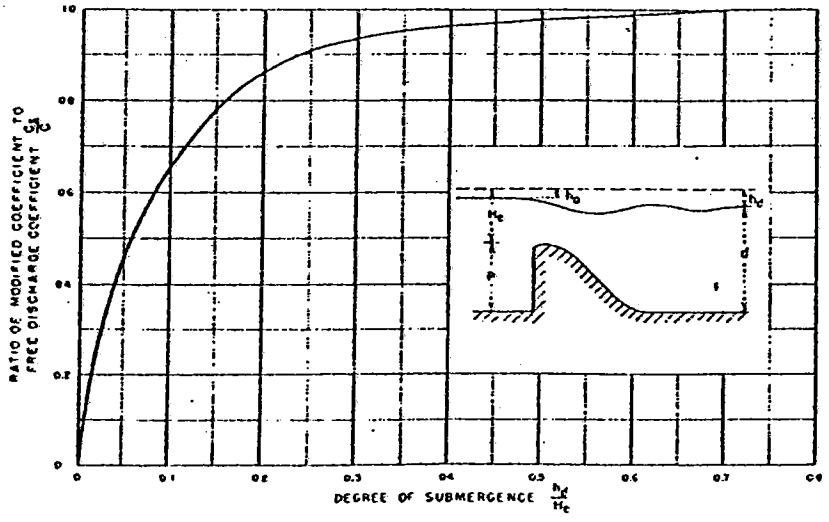
Detention Basin Name	Required Volume (ac-ft)	Actual Volume (ac-ft)
A	4.40	4.41
B	2.30	2.40
D	4.80	4.85

APPENDIX A

DESIGN CHARTS

WEIR FLOW COEFFICIENTS

SHAPE	COEFFICIENT	COMMENTS
Sharp Crested	-	
Projection Ratio (H/P = 0.4)	3.4	H≥1.0
Projection Ratio (H/P = 2.0)	4.0	H≥1.0
Broad Crested	-	
w/Sharp U/S Corner	2.6	Minimum Value
w/Rounded U/S Corner	3.1	Critical Depth
Triangular Section	-	
A) Vertical U/S Slope	-	
1:1 D/S Slope	3.8	H≥0.7
4:1 D/S Slope	3.2	H≥0.7
10:1 D/S Slope	2.9	H≥0.7
B) 1:1 U/S Slope	-	
1:1 D/S Slope	3.8	H≥1.0
3:1 D/S Slope	3.5	
Trapezoidal Section		
1:1 U/S Slope, 2:1 D/S Slope	3.4	H≥1.0
2:1 U/S Slope, 2:1 D/S Slope	3.4	H≥1.0
Road Crossings		
Gravel	3.0	H≥1.0
Paved	3.1	H≥1.0

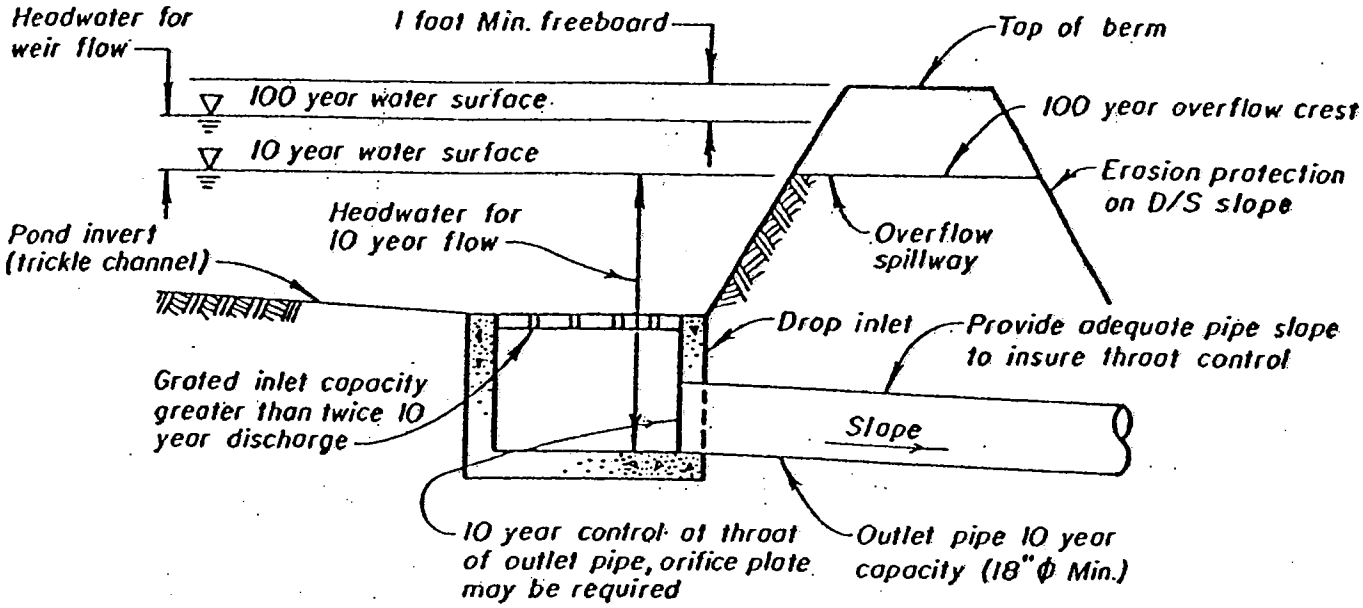


ADJUSTMENT FOR TAILWATER

WRC ENG.

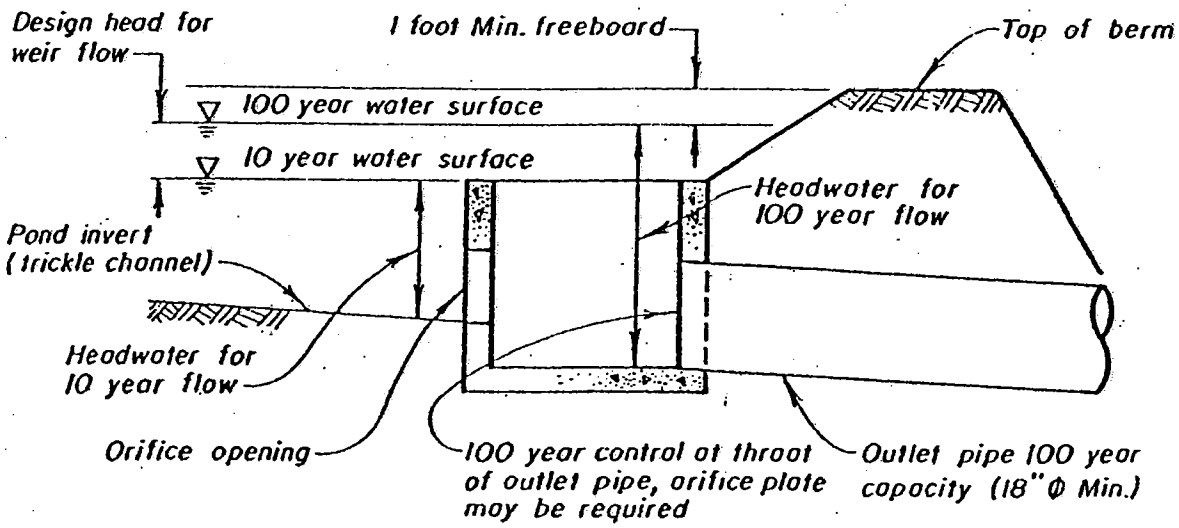
REFERENCE: King & Brater, Handbook of Hydraulics, McGraw Hill Book Company, 1963

DETENTION POND OUTLET CONFIGURATIONS



TYPE 1 OUTLET

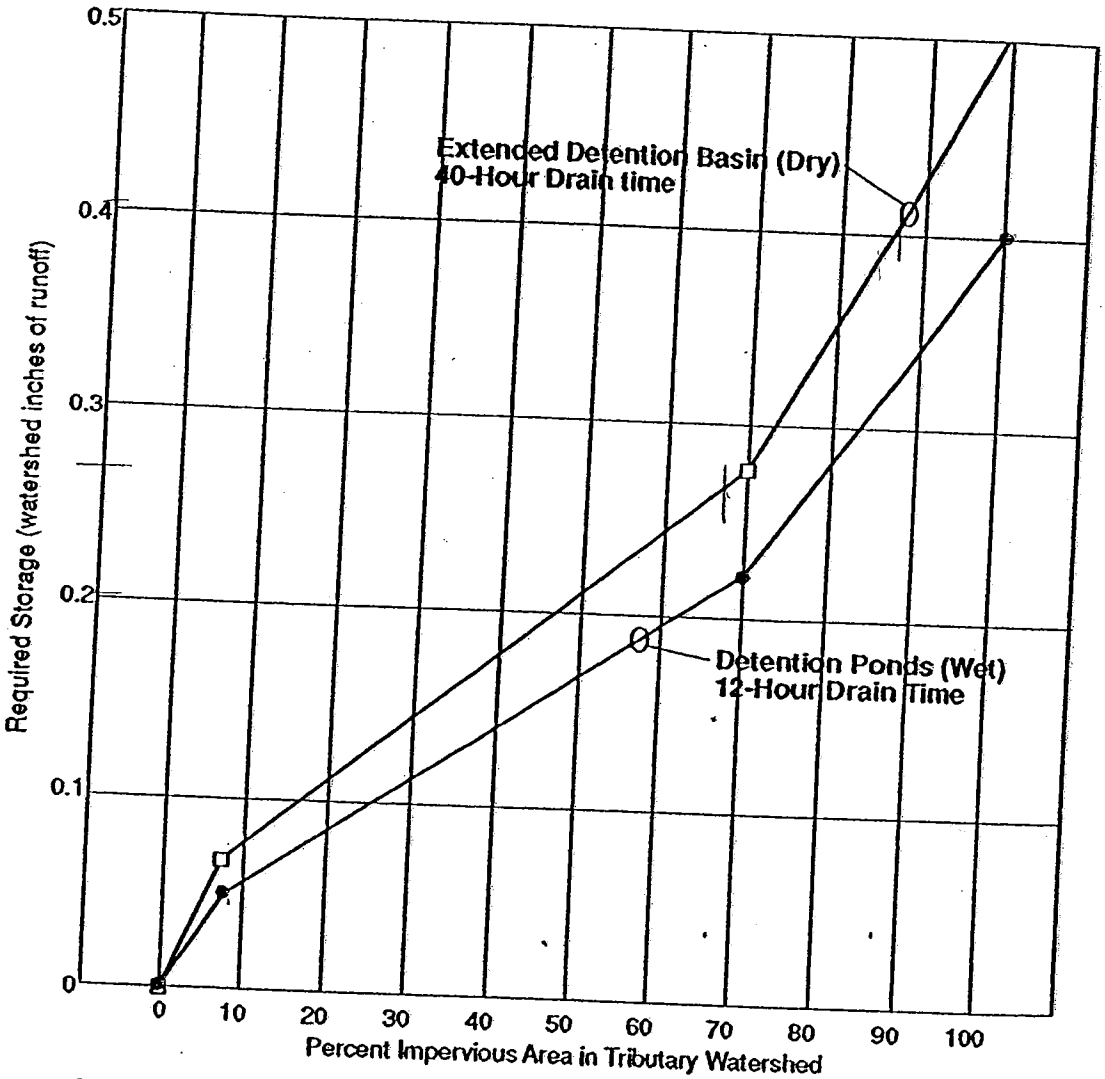
No Scale



TYPE 2 OUTLET

No Scale

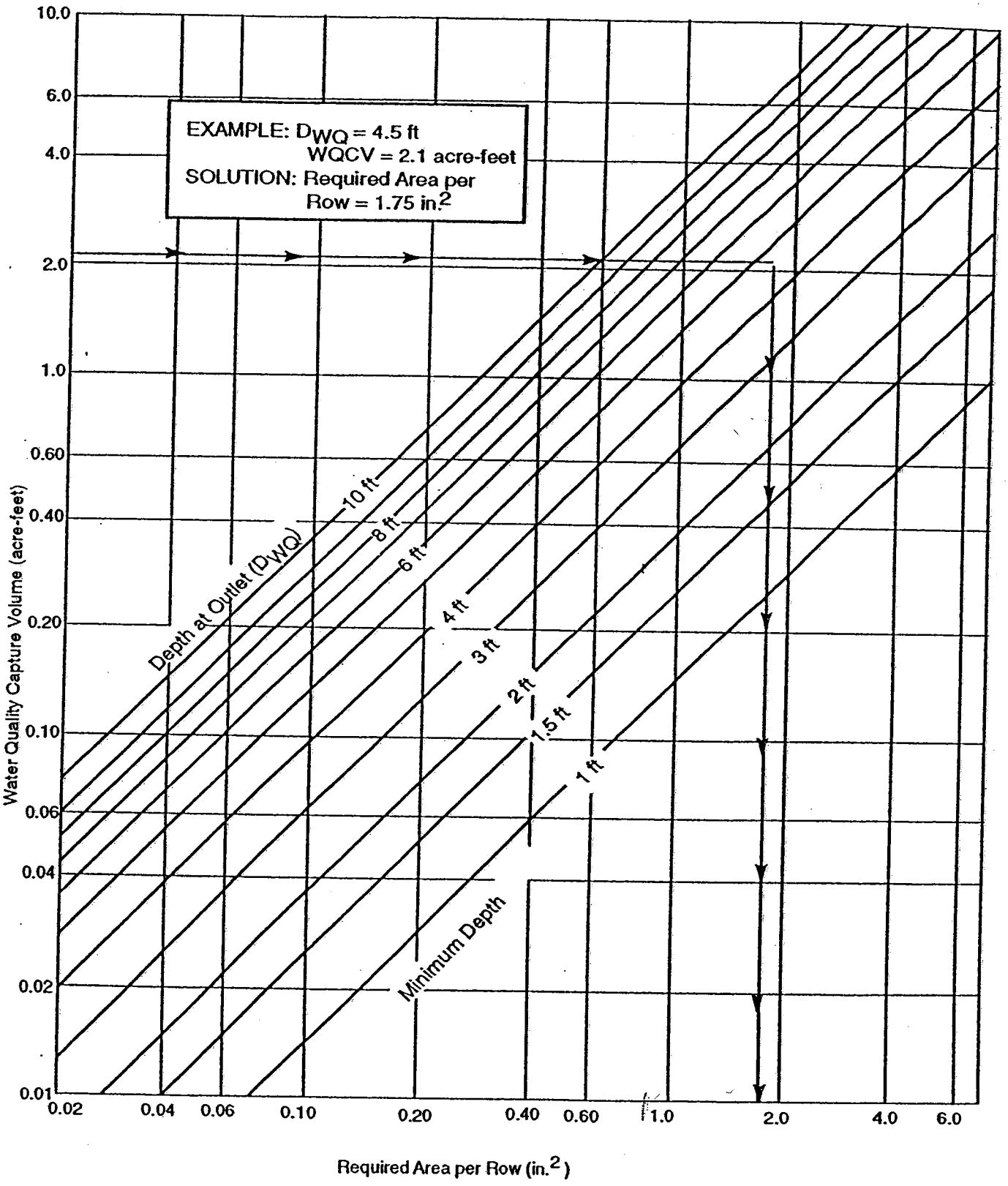
WRC ENG.	REFERENCE:



Source: Urbanos, Guo, Tucker (1989)

Note: Watershed inches of runoff shall apply to the entire watershed tributary to the BMP Facility.

FIGURE 5-1. WATER QUALITY CAPTURE VOLUME (WQCV)



Source: *Douglas County Storm Drainage and Technical Criteria*, 1986.

FIGURE 5-3. WATER QUALITY OUTLET SIZING: DRY EXTENDED DETENTION BASIN WITH A 40-HOUR DRAIN TIME OF THE CAPTURE VOLUME

Orifice Plate Perforation Sizing

Circular Perforation Sizing

Chart may be applied to orifice plate or vertical pipe outlet.

Hole Dia (in)	Hole Dia (in)	Min. Sc (in)	Area per Row (sq in)		
			n=1	n=2	n=3
1/4	0.250	1	0.05	0.10	0.15
5/16	0.313	2	0.08	0.15	0.23
3/8	0.375	2	0.11	0.22	0.33
7/16	0.438	2	0.15	0.30	0.45
1/2	0.500	2	0.20	0.39	0.59
9/16	0.563	3	0.25	0.50	0.75
5/8	0.625	3	0.31	0.61	0.92
11/16	0.688	3	0.37	0.74	1.11
3/4	0.750	3	0.44	0.88	1.33
7/8	0.875	3	0.60	1.20	1.80
1	1.000	4	0.79	1.57	2.36
1 1/8	1.125	4	0.99	1.99	2.98
1 1/4	1.250	4	1.23	2.45	3.68
1 3/8	1.375	4	1.48	2.97	4.45
1 1/2	1.500	4	1.77	3.53	5.30
1 5/8	1.625	4	2.07	4.15	6.22
1 3/4	1.750	4	2.41	4.81	7.22
1 7/8	1.875	4	2.76	5.52	8.28
2	2.000	4	3.14	6.28	9.42
n = Number of columns of perforations					
Minimum steel plate thickness			1/4 "	5/16 "	3/8 "

Rectangular Perforation Sizing

Only one column of rectangular perforations allowed.

Rectangular Height = 2 inches

$$\text{Rectangular Width (inches)} = \frac{\text{Required Area per Row (sq in)}}{2"}$$

Rectangular Hole Width	Min. Steel Thickness
5"	1/4 "
6"	1/4 "
7"	5/32 "
8"	5/16 "
9"	11/32 "
10"	3/8 "
>10"	1/2 "

Urban Drainage and Flood Control District

Drainage Criteria Manual (V.3)

File: V3-Outlet Details.dwg

Figure 5

WQCV Outlet Orifice Perforation Sizing

TABLE 3-1 (42)

RECOMMENDED RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY 2	5	10	100
Business:					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	70	.60	.65	.70	.80
Residential:					
Single-Family	*	.40	.45	.50	.60
Multi-Unit (detached)	50	.45	.50	.60	.70
Multi-Unit (attached)	70	.60	.65	.70	.80
1/2 Acre Lot or Larger	*	.30	.35	.40	.60
Apartments	70	.65	.70	.70	.80
Industrial:					
Light Areas	80	.71	.72	.76	.82
Heavy Acres	90	.80	.80	.85	.90
Parks, Cemetaries:	7	.10	.18	.25	.45
Playgrounds:	13	.15	.20	.30	.50
Schools:	50	.45	.50	.60	.70
Railroad Yard Areas	20	.20	.25	.35	.45
Undeveloped Areas:					
Historic Flow Analysis- Greenbelts, Agricultural	2	(See "Lawns")			
Offsite Flow Analysis (when land use not defined)	45	.43	.47	.55	.65
Streets:					
Paved	100	.87	.88	.90	.93
Gravel (Packed)	40	.40	.45	.50	.60
Drive and Walks:	96	.87	.87	.88	.89
Roofs:	90	.80	.85	.90	.90
Lawns, Sandy Soil	0	.00	.01	.05	.20
Lawns, Clayey Soil	0	.05	.15	.25	.50

NOTE: These Rational Formula coefficients may not be valid for large basins.

*See Figure 2-1 for percent impervious.

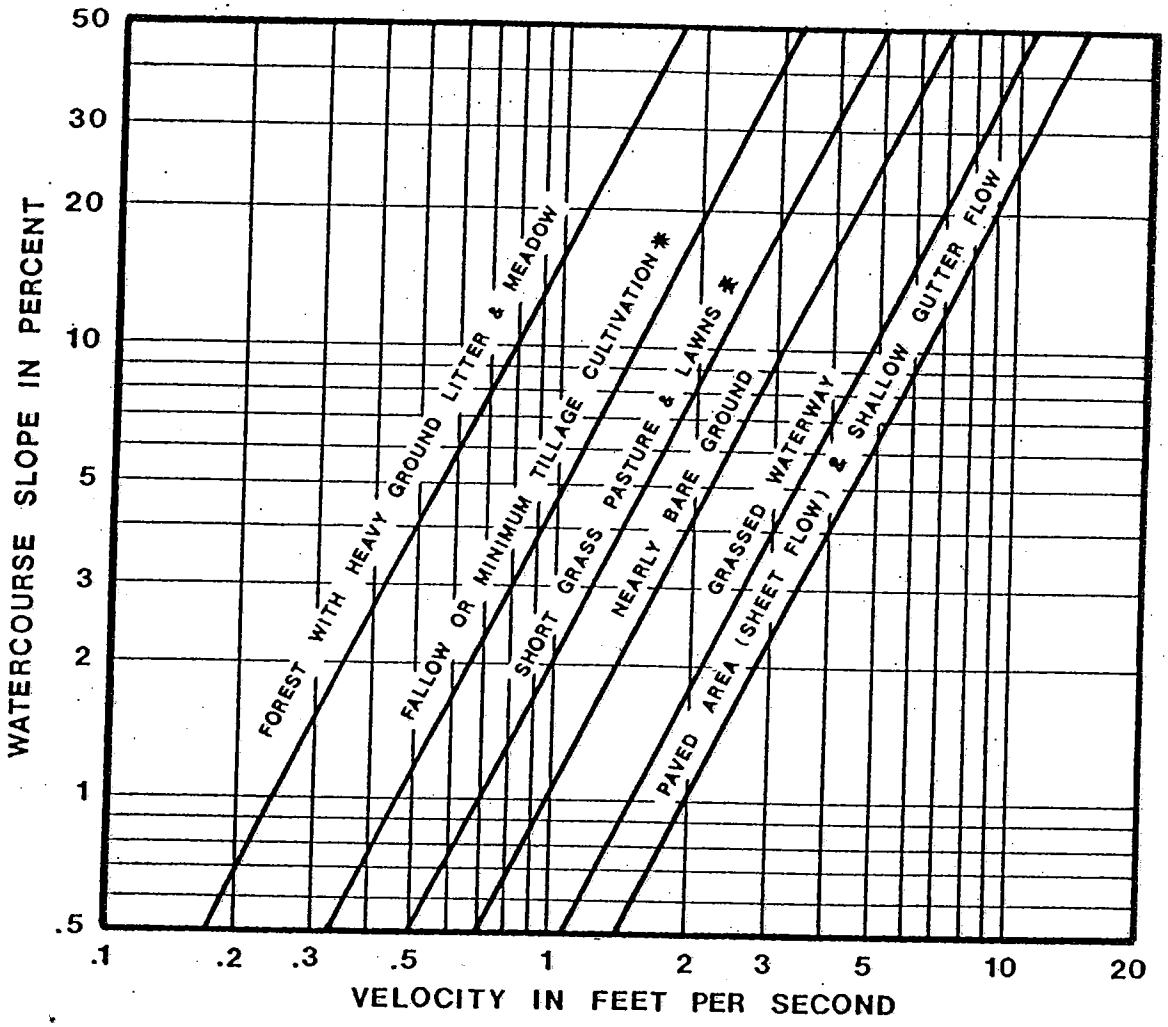


FIGURE 3-2. ESTIMATE OF AVERAGE FLOW VELOCITY FOR USE WITH THE RATIONAL FORMULA.

* MOST FREQUENTLY OCCURRING "UNDEVELOPED" LAND SURFACES IN THE DENVER REGION.

REFERENCE: "Urban Hydrology For Small Watersheds" Technical Release No. 55, USDA, SCS Jan. 1975.

APPENDIX B

SUBBASIN CHARACTERISTICS

Determine subbasin characteristics of revised subbasin delineation

Subbasin H

Area = 988,678 FT² = 22.7 Ac. = 0.0355 mi²

Subbasin B

Area = 213,444 FT² = 4.9 Ac. = 0.0077 mi²

Subbasin C

Area = 69,696 FT² = 1.6 Ac. = 0.0025 mi²

Subbasin E

Area = 362,419 FT² = 6.24 Ac. = 0.010 mi²

Subbasin LW1 (formerly part of H)

Area = 2.79 ac. = 0.0044 mi²

Length = 450' Centroid Distance = 225'

Slope = 2%

t_c (time of concentration) Drainage Criteria Manual urbanized

$$t_c = \frac{L}{180} + 10 = \frac{450}{180} + 10 = 12.5 \text{ min}$$

see attached sheets for complete t_c calcs

Revisions: _____ Date: _____

By: _____

Subbasin LW2

Area = 1.66 ac. = 0.0026 mi^2

Length = 1300' Centroid Distance = 650'

Slope = 2%

$t_c = \frac{1300}{180} + 10 = 17.2$ min (urbanized)

See attached sheet for complete t_c calcs.

Revisions: Date:

By:

Objective to determine time of concentration for basins

Step 1. Determine percent of basin that is parking lot, roof and other for each basin.

Step 2 determine runoff coff for the 5 year (C_5) using Table 3-1 (Urban drainage)

parking lot = 0.87

roofs = 0.85

other = 0.1

C_5 composite = [(parking lot Area) x 0.87 + (roof area) x 0.85 + (other area) x 0.1)] / Total area of basin

Step 3 Determine overland flow time using eq 3.3 (Urban Drainage)

$$t_i = \frac{1.8(1.1 - C_5)\sqrt{L}}{\sqrt[3]{S}}$$

Where t_i = overland flow time (min)
C_5 = 5 yr. frequency runoff coeff.
L = overland flow length (feet)
S = average basin slope (%)

Revisions: ____ Date: ____
By: ____

Step 4

determine the channelized travel time (t_t) using an equation from Urban Drainage

$$t_t = L/60V$$

where t_t = travel time (min)

L = travel length (feet)

V = travel velocity (ft/s)

note travel velocity is determined by using Figure 3-2 from Urban Drainage

Step 5

Determine time of concentration (preliminary)

$$t_c = t_i + t_t$$

Step 6 Determine time of concentration for an urbanized basin using equation 3-4 from Urban Drainage

$$t_c = \frac{L}{180} + 10$$

where t_c = urbanized time of conc. (min)

L = watershed length (ft)

Step 7

use as final t_c lower value determined in step 5 & 6.

Revisions: ____ Date: ____

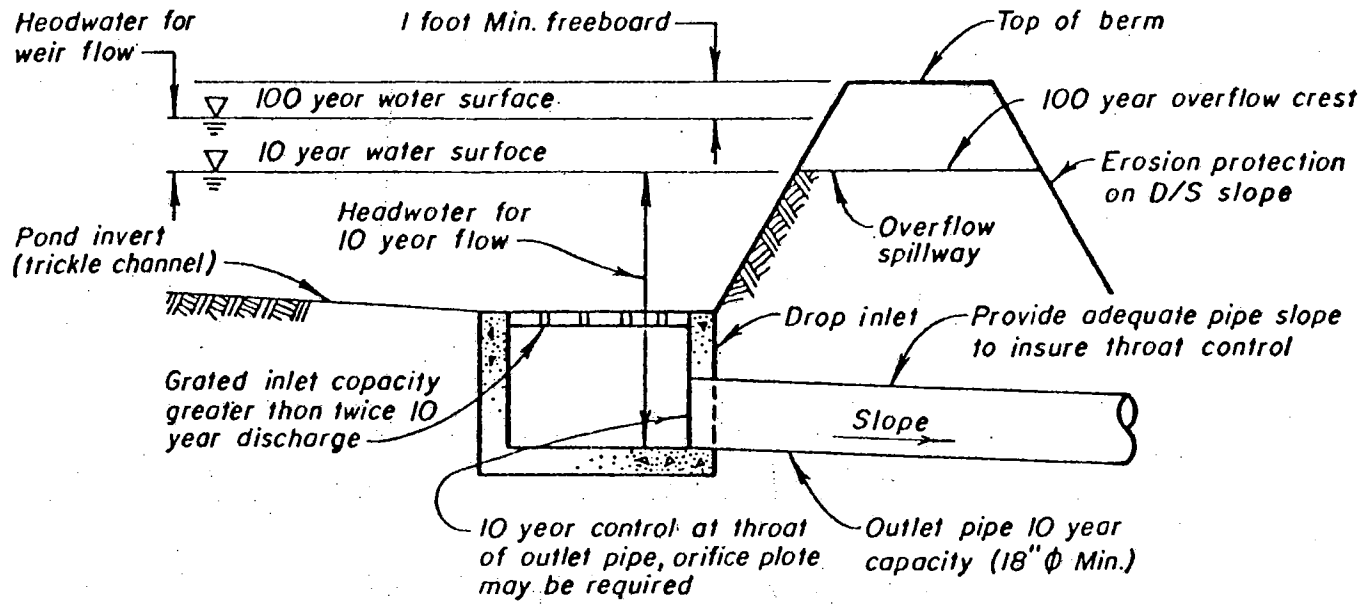
By: ____

Superior Marketplace
118-001

Basin Data		Overland Flow			Channel Flow				tc Check (Urbanized Basins)			Final
Basin	C5	Length, Lo (feet)	Slope, S (%)	Time, ti (min)	Length, Lc (feet)	Slope, S (%)	Velocity, v (fps)	Time, tt (min)	Comp. Tc	Total Length (ft)	tc=(L/180)+ 10	tc (min)
A	0.79	120	2	4.8	500	2.6	3	2.8	7.6	620.0	13.4	7.6
B	0.67	30	2	3.3	570	2.6	3	3.2	6.5	600.0	13.3	6.5
C	0.75	40	2	3.1	200	2	2.8	1.2	4.3	240.0	11.3	4.3
D	0.83	250	2	6.2	650	3.3	3.5	3.1	9.3	900.0	15.0	9.3
E	0.83	100	2.2	3.7	450	4	5	1.5	5.2	550.0	13.1	5.2
F	0.87	350	1.5	6.8	950	2.2	2.8	5.7	12.4	1300.0	17.2	12.4
G	0.73	100	2	5.3	450	3.0	2.8	2.7	7.9	550.0	13.1	7.9
H	0.79	300	3	6.7	1400	2	2.8	8.3	15.0	1700.0	19.4	15.0
I	0.87	300	1.8	5.9	1200	1.8	2.8	7.1	13.0	1500.0	18.3	13.0
LW1	0.79	100	2	4.4	350	2	2.9	2.0	6.4	450.0	12.5	6.4
LW2	0.87	50	2	2.3	1250	2	2.9	7.2	9.5	1300.0	17.2	9.5
HB3	0.10	500	2	31.9	660	3	1.1	10.0	41.9	NA	NA	41.9

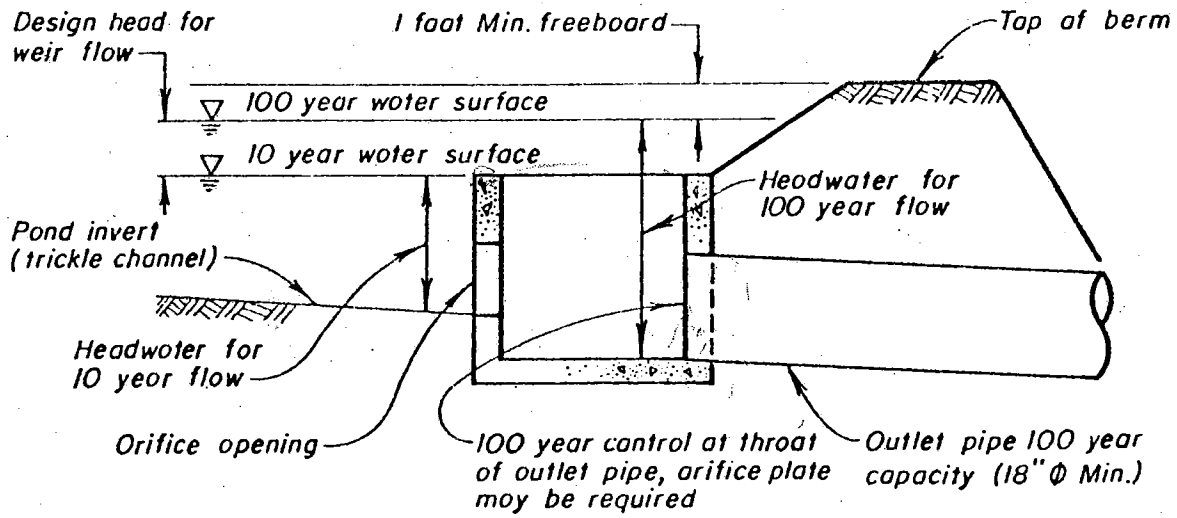
Basin Data	Percent Area			Total Area		
	0.87	0.85	0.1		C5	%impervious
Basin	Parking Lot	Roof	Other	acres		
A	85	5	10	6.62	0.79	90%
B	50	25	25	4.9	0.67	75%
C	70	15	15	1.6	0.75	85%
D	65	30	5	12.88	0.83	95%
E	90	5	5	6.24	0.83	95%
F	100	0	0	20.2	0.87	100%
G	68	15	18	7.4	0.73	82%
H	80	10	10	22.7	0.79	90%
I	100	0	0	2.5	0.87	100%
LW1	90	0	10	2.79	0.79	90%
LW2	100	0	0	1.66	0.87	100%
HB3	0	0	100	8.3	0.10	0%

DETENTION POND OUTLET CONFIGURATIONS



TYPE 1 OUTLET

No Scale



TYPE 2 OUTLET

No Scale

WRC ENG.	REFERENCE:

APPENDIX E

DETENTION BASIN CALCULATIONS

Detention Basin A Outlet
Superior Marketplace
Reference: Boulder County Drainage Criteria (CRITERIA)

Design of Type II Special Outlet
Criteria: 10-year control @ orifice opening or weir notch at drop box
100-year control @ throat of outlet pipe
Weir box flow is 150% of (100-year - 10-year)
WCQV to be released in 40 hrs.

Step 1
Input data in yellow boxes.

	Flow (cfs)	Storage (AF)	Elevation (feet)
100 Year	134	4.4	5506
10 Year	50	2.5	5502
WQ+Sediment		0.48	5497

	Diam. (feet)	Invert Elevation (feet)
Outlet Pipe	6	5493.22
10-year orifice invert		5497
pond bottom		5494

Step 2
Determine WQ outlet design

Depth at Outlet (ft) = 3
Lookup on Figure EDB-3 the Required Area per Row (sq. in.)
a (sq. in.) = 0.75
Lookup on Figure 5 number of colums, hole dia, hole spacing, plate thickness

a (sq. in.) =	0.75	
a (sq.ft.) =	0.005	
number of columns =	3	
Hole Diameter (in) =	9/16	0.56
Minimum Col. Spacing (in) =	3	
Min. Steel Plate Thick. (in) =	3/8	
number of rows =	8	

Ave. Flow (cfs) 100-Year =	0.7
Ave.Flow (cfs) 10-Year =	0.6

Summary: Water Quality Plate requirements are
3/8" min. thick steel plate with 9/16" diam. holes,
3 colums by 8 rows, 3" column spacing, 4" row spacing.

Detention Basin A Outlet
Superior Marketplace
Reference: Boulder County Drainage Criteria (CRITERIA)

Design of Type II Special Outlet

Criteria: 10-year control @ orifice opening or weir notch at drop box
100-year control @ throat of outlet pipe
Weir box flow is 150% of (100-year - 10-year)
WCQV to be released in 40 hrs.

Step 3

Determine size of required outlet throat opening (orifice plate on outlet pipe) for 100-year flow.

eq. 1001 $Q = Cd*A*(2*g*h)^{0.5}$

Q 100 = flow (cfs)
Cd = orifice coefficient (use 0.65 see section 1202.9 CRITERIA)
A = area (sq. ft.)
$g = 32.2\ ft/s^2$
h = head (ft) on culvert from centerline of culvert
h = 100-y elevation - pipe invert - 1/2 pipe diam.

	h (ft) =	9.78
orifice area	A (sq. ft.) =	8.21
orifice diam.	diam. (ft) =	3.2
	diam. (in) =	38.8

orifice plate required	yes
size of plate required (in.)	38.8

note: Inlet nomograph - 38" diam - 134cfs - Hw/D 4, Hw 12.8'

Trash Rack Area Req'd (sq.ft) = 32.9 from Figure 7

Summary: Orifice plate requirement at outlet pipe entrance
circular 38.8" diameter hole, invert at outlet pipe invert

Detention Basin A Outlet
Superior Marketplace
Reference: Boulder County Drainage Criteria (CRITERIA)

Design of Type II Special Outlet

Criteria: 10-year control @ orifice opening or weir notch at drop box
100-year control @ throat of outlet pipe
Weir box flow is 150% of (100-year - 10-year)
WCQV to be released in 40 hrs.

Step 4

Determine notch width for 10 year flow

eq. (703) $Q = C*L*H^{(3/2)}$
Q = 10-Year flow (cfs)
C = Weir Coeff. (use 3.32 for broad crested weir)
L = Horizontal length (ft.)
h = 10-Year Elev. - WQ Elev. head (ft.)

Required L (ft) = 1.3

100-year h (ft) = 9.00
100-Year flow thru notch (cfs) = 119.4

Summary: Weir notch requirement upstream of outlet pipe invert at 5497', length of 1.3', box height at 5502', one side of weir only

Detention Basin A Outlet
Superior Marketplace
Reference: Boulder County Drainage Criteria (CRITERIA)

Design of Type II Special Outlet

Criteria: 10-year control @ orifice opening or weir notch at drop box
100-year control @ throat of outlet pipe
Weir box flow is 150% of (100-year - 10-year)
WCQV to be released in 40 hrs.

Step 5

Determine minimum drop box size.
check weir flow requirements into drop box

eq. (703) $Q = C*L*H^{(3/2)}$
Q = 100-Year req'd - 100-Year (through 10 year orifice or notch flow (cfs)
C = Weir Coeff. (use 3.32 for broad crested weir)
L = Horizontal length (ft.)
h = 100-Year - 10-Year head (ft.)

Q 100 (cfs) = 120.1 use wq 100 year plus 10 year notch or weir
weir box length req'd as below
L (ft) = 0.52
Use 150% of L calculate
min. L (ft) = 0.78
Use for 1 side of drop box at 10 year elevation

USE 6"x24" spaced bars for TRASH RACK
Minimum Drop Box Size > 32.9 sq. ft.

Summary: Drop Box dimensions
5.5' x 6' box

HYDRO-TRIAD / V3 COLORADO, LLC

One of the V3 Companies

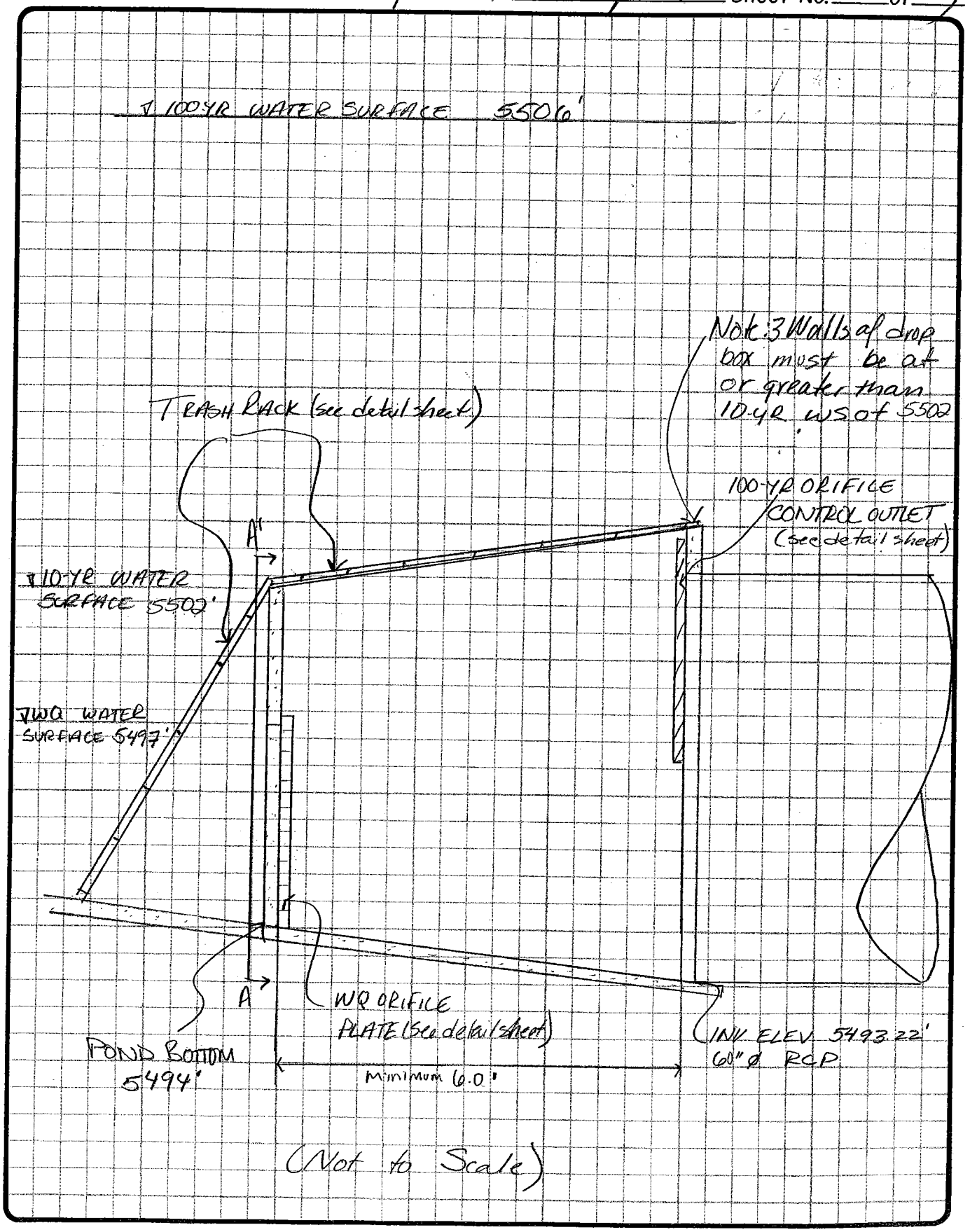
CALCULATION SHEET

By: LSW Date: 8/31/99 Subject: OUTLET STRUCTURE A Job No.: 118-005

Checked: ____ Date: ____ Superior Marketplace Sheet No. 1 of 3

Revisions: ____ Date: ____

By: ____



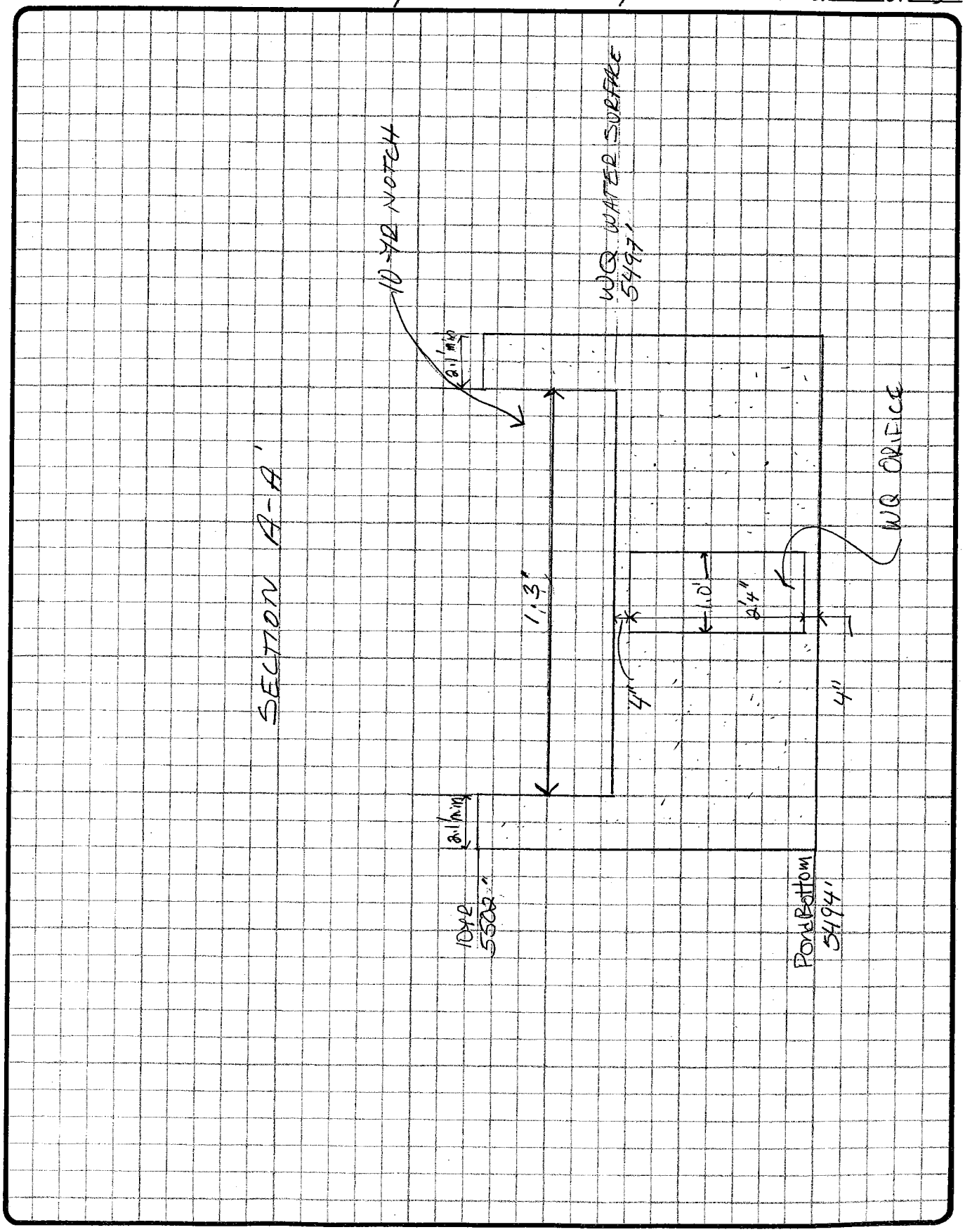
HYDRO-TRIAD / V3 COLORADO, LLC

One of the V3 Companies

CALCULATION SHEET

By: LSW Date: 8/31/22 Subject: OUTLET STRUCTURE A Job No.: 118005

Checked: ____ Date: ____ Superior Marketplace Sheet No. 2 of 3



Revisions: ____ Date: ____

By: ____

HYDRO-TRIAD / V3 COLORADO, LLC

CALCULATION SHEET

One of the V3 Companies

By: LSW Date: 8/31/99 Subject: OUTLET STRUCTURE A Job No.: 118-005

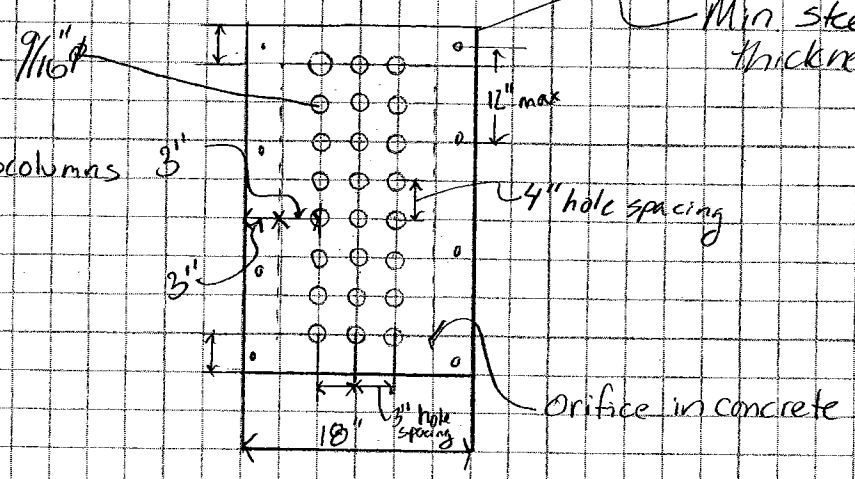
Checked: ____ Date: ____ Sheet No. 3 of 3

Revisions: ____ Date: ____

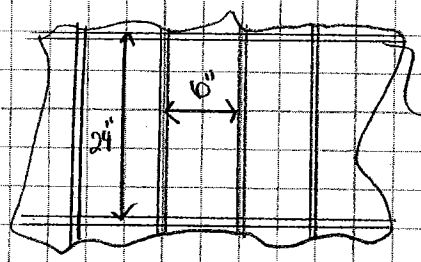
By: ____

Detail Sheet

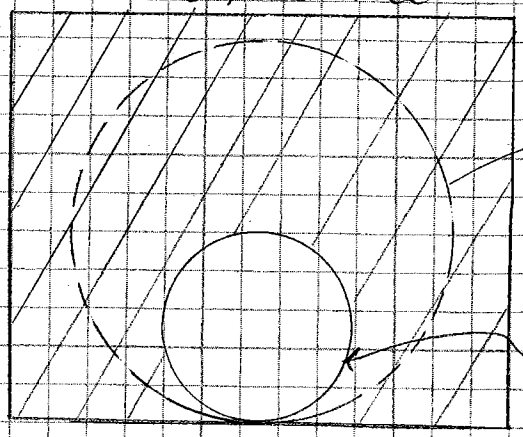
Water Quality Orifice Plate

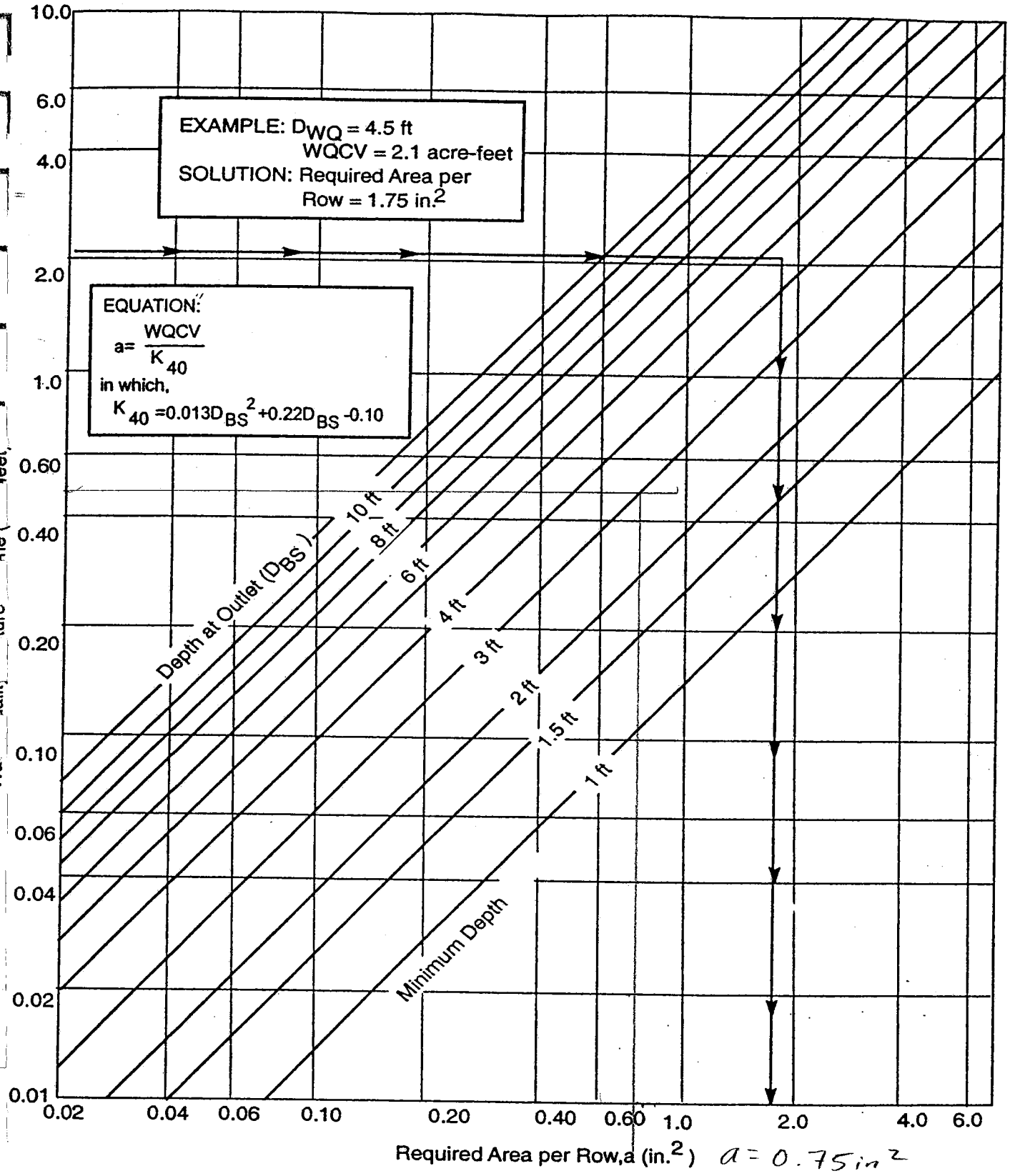


TRASH RACK DETAIL



100-YR ORIFICE





Source: *Douglas County Storm Drainage and Technical Criteria*, 1986.

FIGURE EDB-3. WATER QUALITY OUTLET SIZING: DRY EXTENDED DETENTION BASIN WITH A 40-HOUR DRAIN TIME OF THE CAPTURE VOLUME

Detention Basin B Outlet
Superior Marketplace
Reference: Boulder County Drainage Criteria (CRITERIA)

Design of Type II Special Outlet
Criteria: 10-year control @ orifice opening or weir notch at drop box
100-year control @ throat of outlet pipe
Weir box flow is 150% of (100-year - 10-year)
WCQV to be released in 40 hrs.

Step 1
Input data in yellow boxes.

	Flow (cfs)	Storage (AF)	Elevation (feet)
100 Year	64	2.3	5505
10 Year	10	2	5504
WQ+Sediment		0.9	5500

	Diam. (feet)	Invert Elevation (feet)
Outlet Pipe	3	5495
10-year orifice invert		5500
pond bottom		5495

Step 2
Determine WQ outlet design

Depth at Outlet (ft) = 5
Lookup on Figure EDB-3 the Required Area per Row (sq. in.)
a (sq. in.) = 0.7
Lookup on Figure 5 number of colums, hole dia, hole spacing, plate thickness

a (sq. in.) =	0.75	
a (sq.ft.) =	0.005	
number of columns =	3	
Hole Diameter (in) =	9/16	0.5625
Minimum Spacing (in) =	3	
Min. Steel Plate Thick. (in) =	3/8	
number of rows =	14	

Ave. Flow (cfs) 100-Year =	0.63
Ave.Flow (cfs) 10-Year =	0.59

Summary: Water Quality Plate requirements are
3/8" min. thick steel plate with 9/16" diam. holes,
3 colums by 14 rows, 3" column spacing, 4" row spacing.

Detention Basin B Outlet
Superior Marketplace
Reference: Boulder County Drainage Criteria (CRITERIA)

Design of Type II Special Outlet

Criteria: 10-year control @ orifice opening or weir notch at drop box
100-year control @ throat of outlet pipe
Weir box flow is 150% of (100-year - 10-year)
WCQV to be released in 40 hrs.

Step 3

Determine size of required outlet throat opening (orifice plate on outlet pipe) for 100-year flow.

eq. 1001 $Q = Cd*A*(2*g*h)^{0.5}$
Q 100 = flow (cfs)
Cd = orifice coefficient (use 0.65 see section 1202.9 CRITERIA)
A = area (sq. ft.)
g = 32.2 ft/s^2
h = head (ft) on culvert from centerline of culvert
h = 100-y elevation - pipe invert - 1/2 pipe diam.

	h (ft) =	8.5
orifice area	A (sq. ft.) =	4.21
orifice diam.	diam. (ft) =	2.3
	diam. (in) =	27.8

orifice plate required	yes
size of plate required (in.)	27.8

Trash Rack Area Req'd (sq.ft) = 16.8 from Figure 7

Summary: Orifice plate requirement at outlet pipe entrance circular 27.8" diameter hole, invert at outlet pipe invert

Detention Basin B Outlet
Superior Marketplace
Reference: Boulder County Drainage Criteria (CRITERIA)

Design of Type II Special Outlet

Criteria: 10-year control @ orifice opening or weir notch at drop box
100-year control @ throat of outlet pipe
Weir box flow is 150% of (100-year - 10-year)
WCQV to be released in 40 hrs.

Step 4

Determine notch width for 10 year flow

Q = C*L*H^(3/2)
Q = 10-Year flow (cfs)
C = Weir Coeff. (use 3.32 for broad crested weir)
L = Horizontal length (ft.)
h = 10-Year Elev. - WQ Elev. head (ft.)

L (ft) = 0.35

100-year h (ft) = 5.00
100-Year flow thru notch (cfs) = 13.1

Summary: Weir notch requirement upstream of outlet pipe invert at 5500', length of 0.35', box height at 5504', one side of weir only

Detention Basin B Outlet
Superior Marketplace
Reference: Boulder County Drainage Criteria (CRITERIA)

Design of Type II Special Outlet
Criteria: 10-year control @ orifice opening or weir notch at drop box
100-year control @ throat of outlet pipe
Weir box flow is 150% of (100-year - 10-year)
WCQV to be released in 40 hrs.

Step 5
Determine minimum drop box size.
check weir flow requirements into drop box
eq. (703) Q = C*L*H^(/32)
Q = 100-Year req'd - 100-Year (through 10 year orifice or notch flow (cfs)
C = Weir Coeff. (use 3.32 for broad crested weir)
L = Horizontal length (ft.)
h = 100-Year - 10-Year head (ft.)

Q 100 (cfs) = 13.8 flowing through notch and wq orifice
weir box length req'd as below
L (ft) = 15.13
Use 150% of L calculate
min. L (ft) = 22.69
Use for 3 sides of drop box at 10 year elevation

USE 6"x24" spaced bars for TRASH RACK
Minimum Weir Box Size > 16.8 sq. ft.

Summary: Drop Box dimensions
10' x 6.5' box

HYDRO-TRIAD / V3 COLORADO, LLC

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CALCULATION SHEET

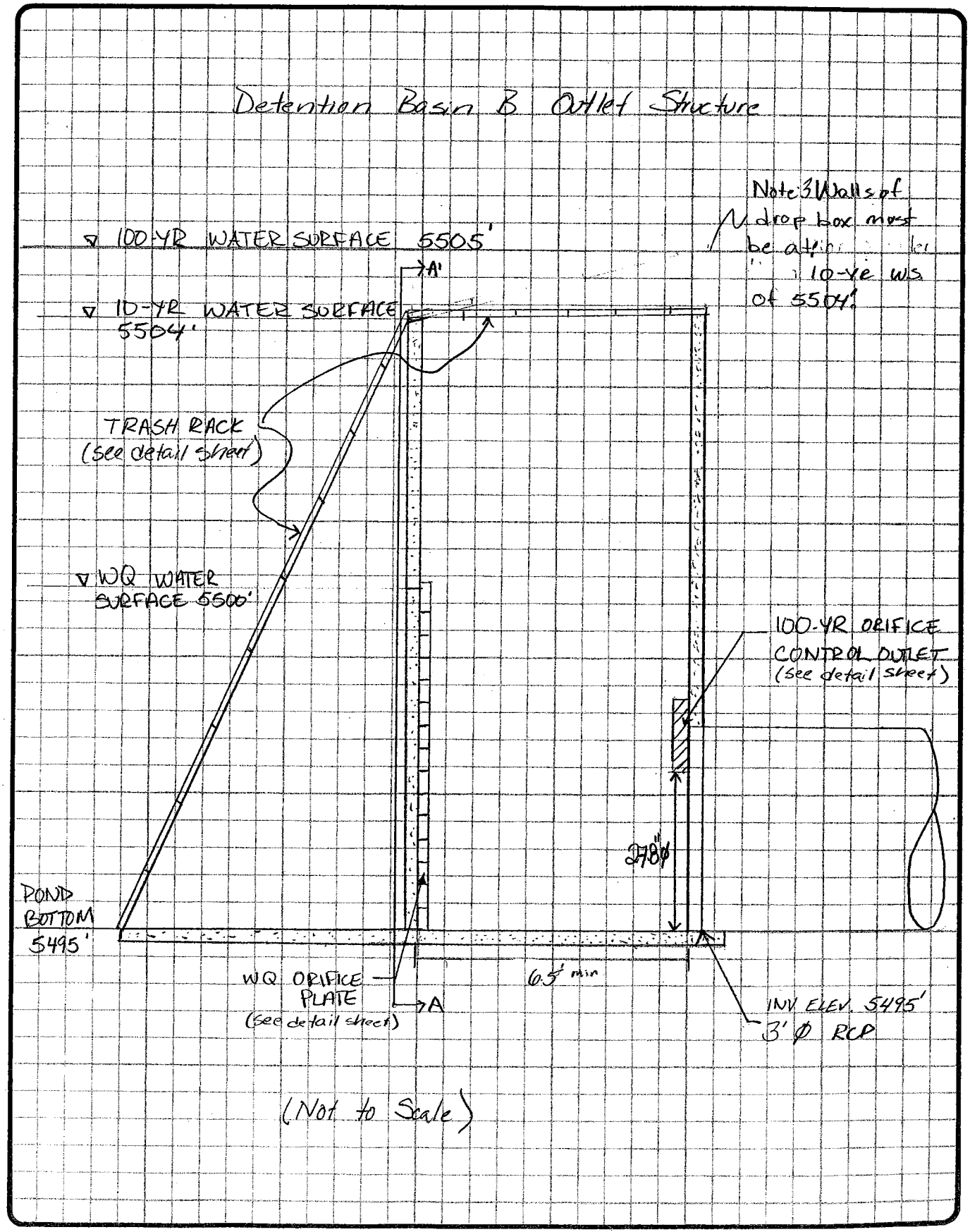
By: LSW Date: 8/31/99 Subject: OUTLET STRUCTURE B Job No.: 118-005

Checked: ____ Date: ____ SUPERIOR MARKET PLACE Sheet No. 1 of 3

Revisions: ____ Date: ____

By: ____

Detention Basin B Outlet Structure



(Not to Scale)

HYDRO-TRIAD / V3 COLORADO, LLC

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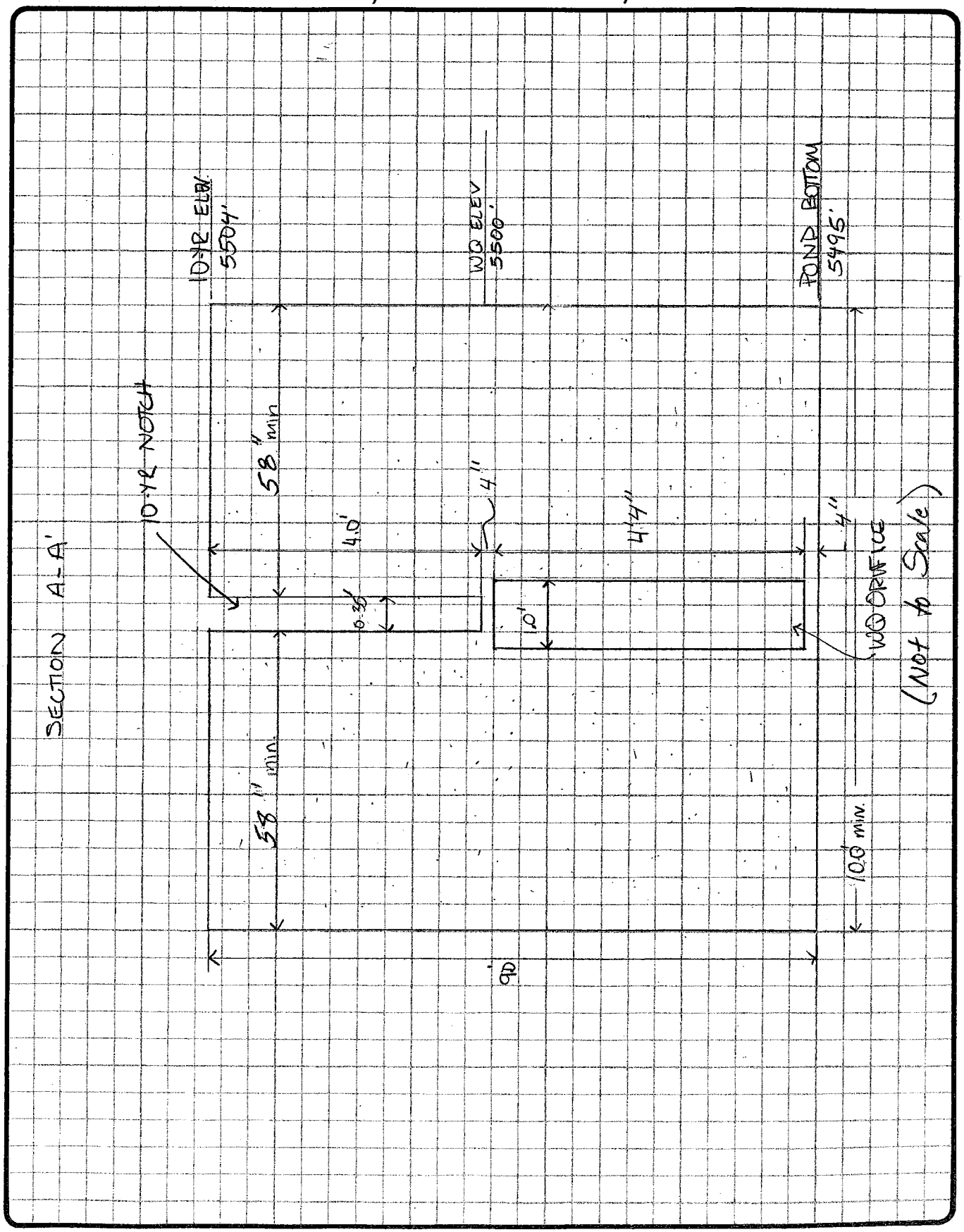
CALCULATION SHEET

By: LSW Date: 8/31/99 Subject: OUTLET STRUCTURE B Job No.: 118-005

Checked: ____ Date: ____ Superior Marketplace Sheet No. 2 of 3



Revisions: ____ Date: ____

By: ____

HYDRO-TRIAD / V3 COLORADO, LLC

CALCULATION SHEET

One of the V3 Companies

By: LSW Date: 8/31/99 Subject: Outlet Structure B Job No.: 118-005

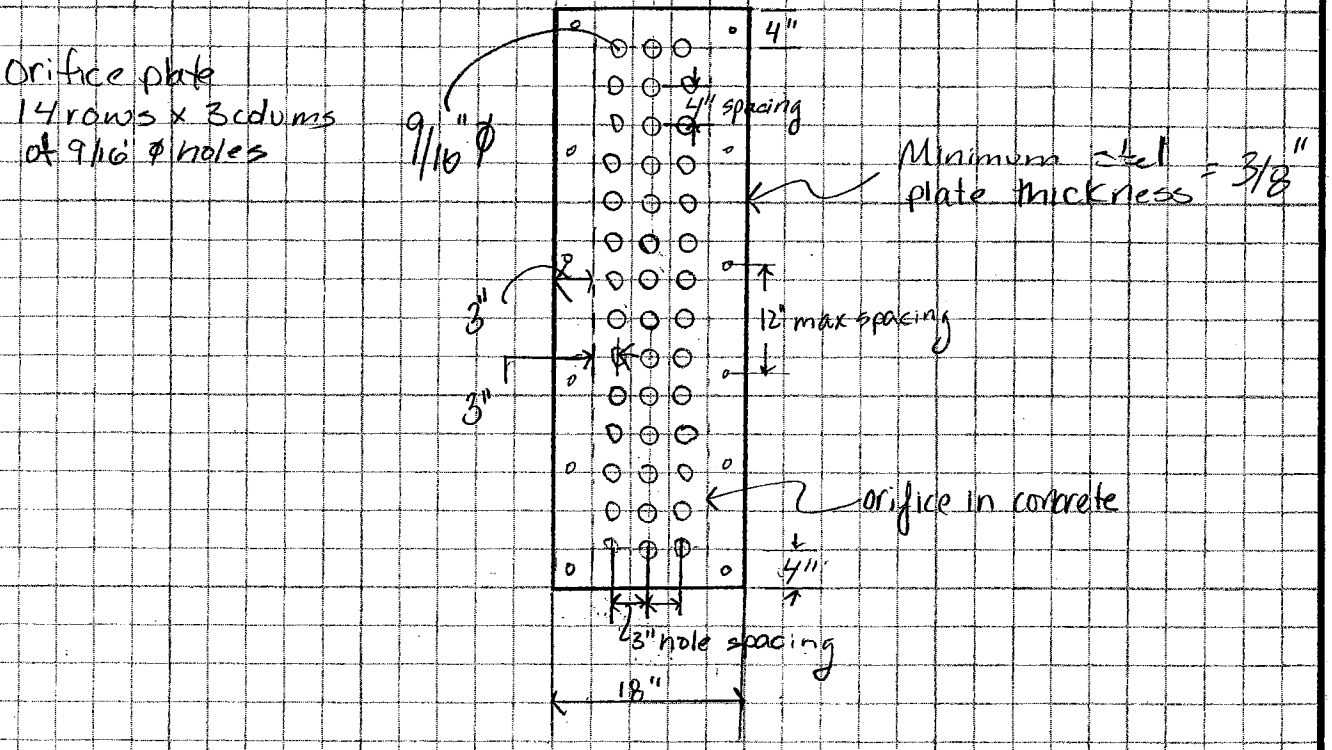
Checked: ____ Date: ____ Superior Marketplace Sheet No. 3 of 3

Revisions: ____ Date: ____

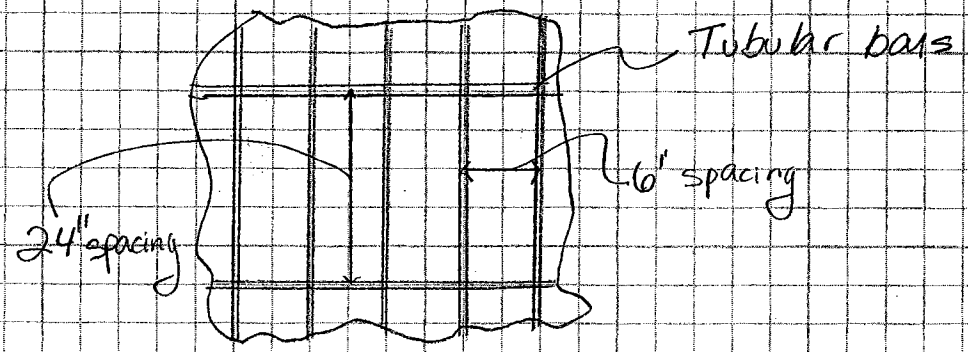
By: ____

Detail Sheet

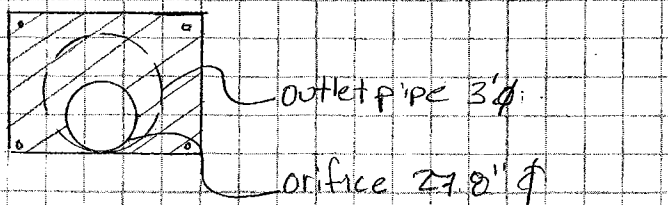
Water Quality Orifice plate

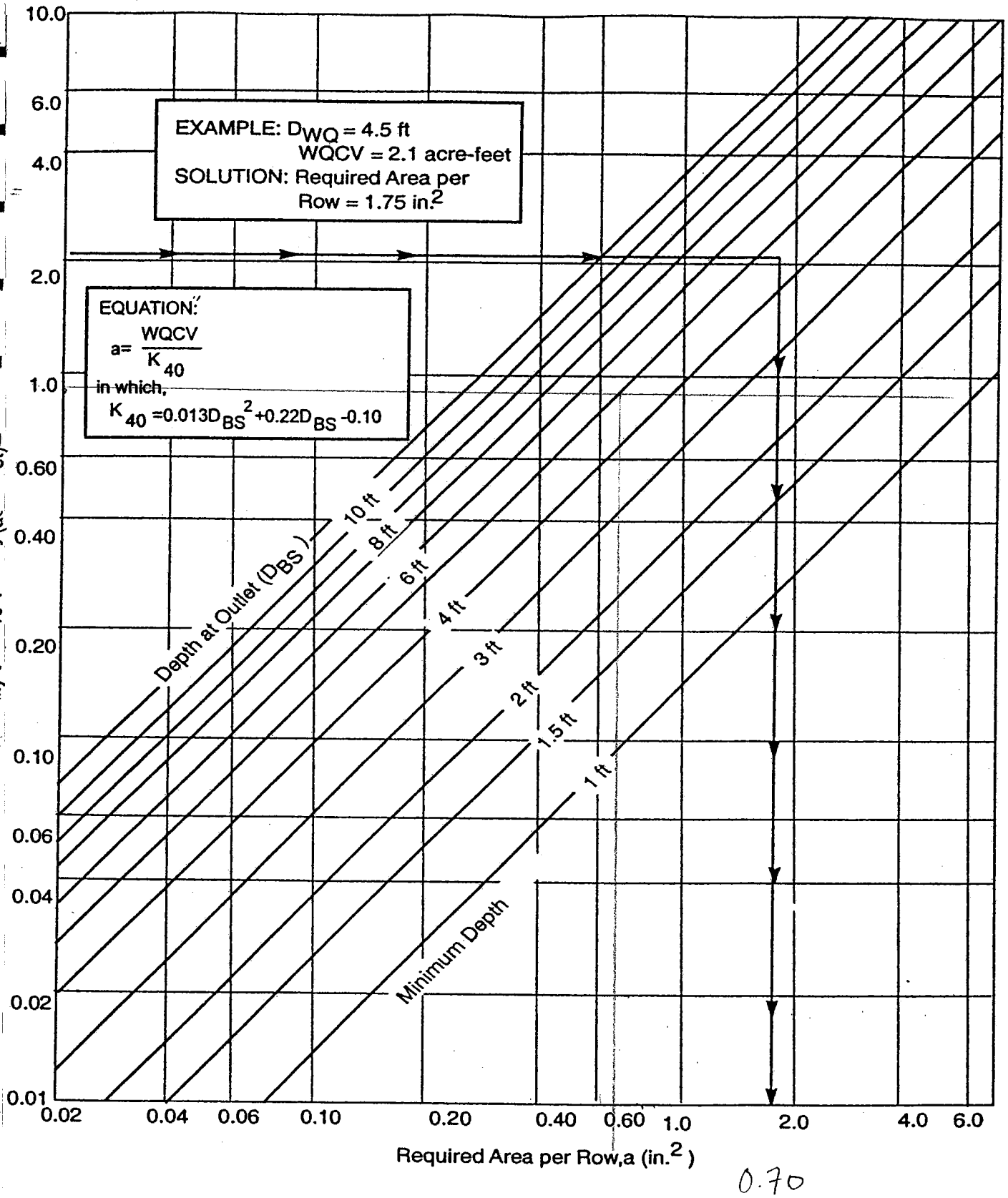


TRASH RACK DETAIL



100-YR Orifice Plate





0.70

Source: *Douglas County Storm Drainage and Technical Criteria*, 1986.

FIGURE EDB-3. WATER QUALITY OUTLET SIZING: DRY EXTENDED DETENTION BASIN WITH A 40-HOUR DRAIN TIME OF THE CAPTURE VOLUME

Rev. 3-1-1994
UDFCD

APPENDIX F

WATER QUALITY CAPTURE VOLUME AND SEDIMENT CALCULATIONS

HYDRO-TRIAD / V3 COLORADO, LLC

CALCULATION SHEET

One of the V3 Companies

By: LSW Date: 6/28/99 Subject: Detention Basins Job No.: 118-001-.4

Checked: RMO Date: 7/9/99 Water Quality Sheet No. 1 of

Objective

Determine Water Quality Capture Volume (WQCV) and Sediment Volume for each detention basin.

Method

Urban Drainage Criteria Manual

Section 5.4.2 WQCV [Stormwater Quality Management]

1. Determine basin impervious
2. Select 40-hr detention time dry extended detention basins
3. Use Figure 5-1 to determine required storage
4. Determine WQCV as follows

$$WQCV = \left[\frac{\text{Required Storage}}{12}\right](\text{Area})$$

WQCV (acre-feet)
Required Storage (watershed inches)
Area (acres)

Section 5.5 [Structural BMPs] Sediment

Sediment requirement is 20% of WQCV

See attached table for WQCV & sediment calcs.

Revisions: _____ Date: _____

By: _____

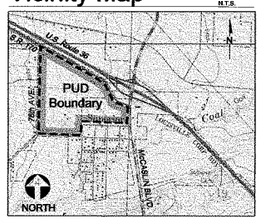
Date 8/16/99
Engineer LSW
Checked By MC

WQCV and Sediment Calculations
Superior Marketplace 118-001.4

Contributary Basins	Basin Area (acres)	Percent Impervious / Contributary Basin	Total Percent Impervious	Required Storage (watershed inches)	WQCV (ac-ft)	Sediment (ac-ft)	WQCV and Sediment (ac-ft)
			Detention Area A				
A	6.6	90					
B	4.9	75					
C	1.6	85					
Total	13.1		83.8	0.37	0.40	0.08	**0.48**
			Detention Area B				
D	12.9	95					
E	6.2	95					
Total	19.1		95.0	0.47	0.75	0.15	**0.90**
			Detention Area D				
H	22.7	90					
I	2.5	100					
LW1	2.8	90					
Total	28		90.9	0.44	1.03	0.21	**1.23**

Notes:
1. Total Percent Impervious was determined by summing the individual basin areas times the individual % impervious and dividing by the total area.
2. Required storage in watershed inches was determined from Figure 5-1 Water Quality Capture Volume in Urban Drainage Criteria Manual.
3. WQCV was determined by multipling Required Storage divided by 12 by total area.
4. Sediment was determined by multiplying WQCV by 20%.

Vicinity Map



LEGEND

- WATERSHED AREA BOUNDARY
- SUBBASIN (G / 7.4)
- AREA *(acres)*
- EXISTING STORM WATER LINE
- PROPOSED STORM WATER LINE
- 5542 REGRADING TOPOGRAPHY *(C.I. = 2FT)*
- DIVERSION STRUCTURE
- RETAINING WALL FOR DETENTION FACILITY

NOTES

1. THE FOLLOWING SUBBASINS, WHICH ARE PART OF THE MASTER DRAINAGE PLAN, ARE NOT SHOWN: EMK6, M1, M3, M3A, M3B, M4, M4A & M4B.
2. THE FOLLOWING SUBBASINS, F, G AND I, PREVIOUSLY DELINEATED BY MARTIN/MARTIN AND M1, M3, M3A, M3B, M4, M4A AND M4B PREVIOUSLY DELINEATED BY McLAUGHLIN WATER ENGINEERS, WERE NOT MODIFIED BY HT/V3.
3. NORTH OUTLET STRUCTURE OF DETENTION BASIN IN SAGAMORE SUBDIVISION TO BE ABANDONED.
4. SOUTH OUTLET STRUCTURE OF THE DETENTION BASIN IN SAGAMORE SUBDIVISION TO BE MODIFIED.
5. OUTLET TO POND 11 TO BE MODIFIED.

Superior Marketplace Drainage Summary

Unit	Description	Peak Developed Flows (cfs) 10-Year	Peak Developed Flows (cfs) 100-Year	Storage (acre-feet) 10-Year	Storage (acre-feet) 100-Year
113	Design Point (Subbasin HB3)*	4	12	NA	
111	Design Point (Sagamore Subdivision)	51	197	NA	
516	Design Point (Diversion Structure for Detention Basin A)	83	258	NA	
515	Conveyance Unit (Bypass for Detention Basin A)	11	89	NA	
201	Detention Basin A	50	134	2.5	4.4
110	Conveyance Unit (EMK Basin 6)	80	229	NA	
203	Detention Basin B	10	64	2.0	2.3
500	Design Point (Diversion Structure for Detention Basin D and CDOT Swale)	99	321	NA	
501	Design Point (Diversion to the CDOT Swale)	92	285	NA	
205	Detention Basin D	10	40	2.8	4.8
105	Conveyance Unit (Flows from Superior Marketplace)	67	244	NA	
160	Design Point (Flows from McCaslin Blvd.)	55	114	NA	
211	Existing Detention Basin 11	74	238	3.8	9.0

* Historic flows are reported for Subbasin HB3.

- N -

Scale : 1"=120'

0 250 FEET

EMK Offsite Basin 6 152ac Q10=80cfs Q100=229cfs

76th Ave

Existing Detention Basin C *(By Martin/Martin)*

Diversion Structure D

C-DOT Swale

EXISTING 2-60" RCPS

Detention Basin B1 *(see Dwg. 3.0)*

Marshall Road

Detention Basin A2 *(see Dwg. 3.0)*

Detention Basin D *(see Dwg. 3.0)*

EXISTING 6'x4' BOX CULVERT

Sagamore Subdivision Q10=51cfs Q100=197cfs *(see Notes 3 & 4)*

Sycamore St

Diversion Structure A

Detention Basin A1 *(see Dwg. 3.0)*

Town of Superior, Historic Q10=4cfs Q100=12cfs

McCaslin Blvd. Q10=55cfs Q100=114cfs

McCaslin Blvd

Existing Regional Detention Basin 11 *(By E.M.K.)* *(see Note 5)*

I 2.5 · F 20.2 · G 7.4 · LW1 2.79 · H 22.7 · D 12.88 · E 6.24 · LW2 1.66 · C 1.6 · A 6.62 · B 4.9 · MR1 3.8 · HB3 8.3

V:\Fig No. 1609137.dwg

DETENTION BASIN DELINEATION

MASTER DRAINAGE STUDY
SUPERIOR MARKETPLACE

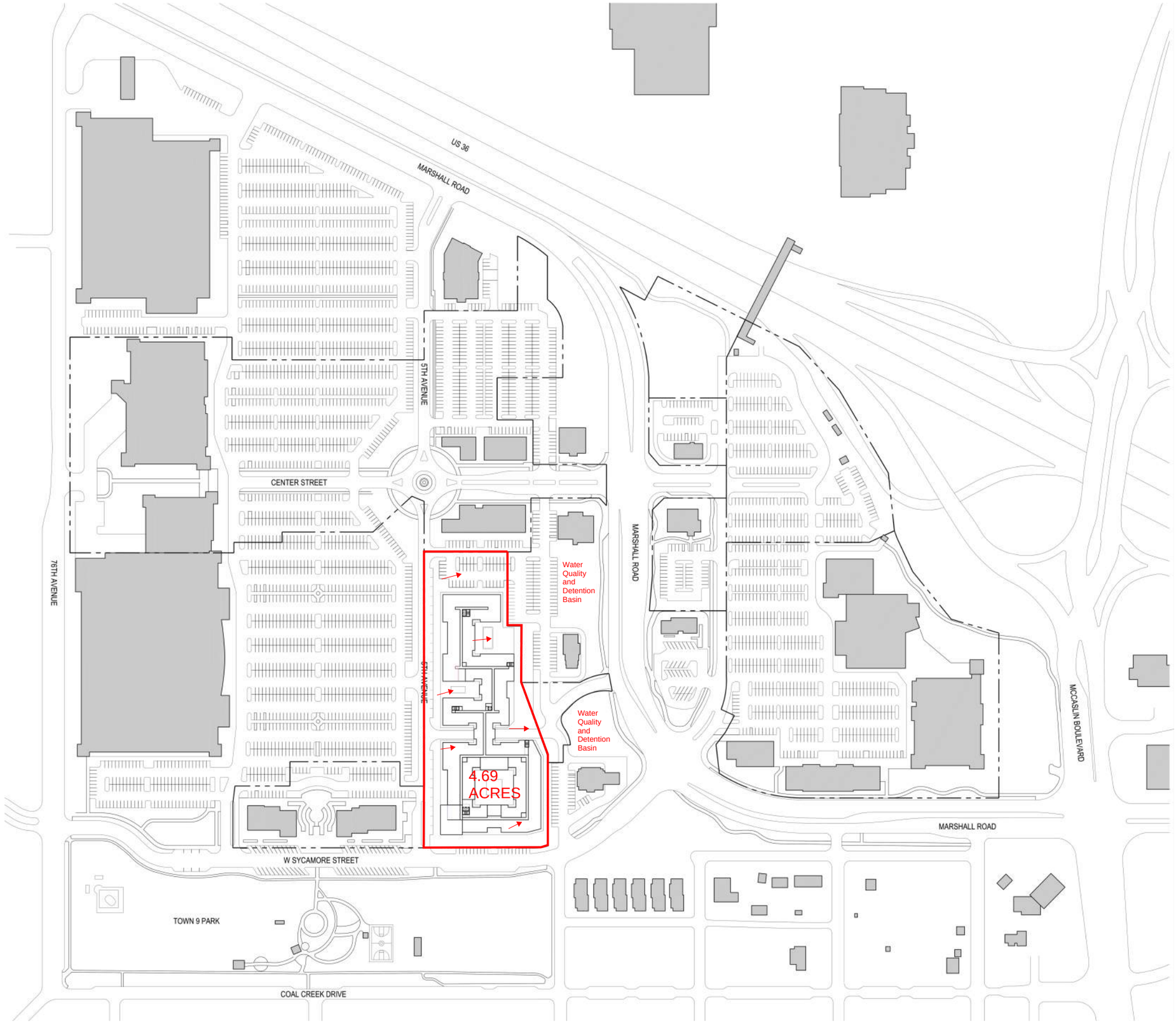
1.0

HYDRO-TRIAD / V3 COLORADO, LLC
200 Union Blvd., Suite 200
Lakewood, Colorado 80228

7 July 1999	SUBMITTED FOR REVIEW
23 July 1999	GENERAL REVISIONS
6 August 1999	GENERAL REVISIONS
17 Sept. 1999	GENERAL REVISIONS

APPENDIX C

Proposed Site Location



CRAINE ARCHITECTURE

CONFLUENCE companies

SUPERIOR MARKETPLACE
RESIDENTIAL DEVELOPMENT

5TH AVENUE
SUPERIOR, COLORADO

ISSUE:

Date:	Issue:	Rev.:

CA PROJECT NO: CA 22-002

Overall Site Plan

A100